4. WORK PLAN RATIONALE

The following sections present the rationale for performing the OU 3-14 RI/FS. Discussed are the assumptions that impact OU 3-14, the major uncertainties that drive project needs, the explanation of OU 3-14 data quality objectives, and the major elements of the field investigations.

4.1 OU 3-13 and OU 3-14 Remedial Investigation/Feasibility Study Assumptions

This section presents the assumptions from the OU 3-13 RI/FS (DOE-ID 1997b) and the FS Supplement (DOE-ID 1998a) that will be incorporated in the OU 3-14 FS. Though some of the principal assumptions remain the same as those made in the OU 3-13 RI/FS, modifications may be necessary because of changes in the project's scope. The purpose of this section is to present the assumptions that will be used in the OU 3-14 FS to bound the range of potential remedial alternatives that will be considered for Tank Farm soil, INTEC injection well and aquifer within the INTEC fence line, and the additional sites from OU 3-13. The assumptions are presented in terms of remedial action objective (RAO) development, integration with parallel programs (i.e., RCRA and NEPA), investigation-derived waste management, operational interfaces, Tank Farm closure, innovative technology considerations, on-site consolidation of contaminated soil, WAG interfaces, transuranic waste considerations, and long-term land use and risk-assessment assumptions.

4.1.1 Assumptions for Preliminary RAO Development

The primary purpose of the FS is to develop, analyze, and compare appropriate remedial responses that will reduce unacceptable risks to human health and the environment. Remedial alternatives are identified and evaluated, in part, based on their ability to meet the RAOs. The RAOs are clear and specific statements that describe the cleanup goals for a remedial action and are expressed on a media- and contaminant-specific basis. The assumptions used to develop the RAOs for the OU 3-13 RI/FS and, where necessary, the recommended changes to those assumptions for use in the OU 3-14 RI/FS are described in this section.

4.1.1.1 OU 3-13 Assumptions Applicable to OU 3-14. These OU 3-13 assumptions are applicable to OU 3-14:

- Any potential risk from radionuclides via the air pathway is associated with remedial actions and those risks will be addressed and mitigated through engineered controls. A conclusion of the OU 3-13 BRA (DOE-ID 1997a) was that no total excess cancer risks exceed 1E-06 for the air pathway. This approach is retained for OU 3-14.

- Remedial action objectives for soil and groundwater media will be developed, by OU 3-14 COC, for the time period before 2095, and additional RAOs for soil and groundwater media will be developed, by OU 3-14 COC, for post-2095. This approach is retained for OU 3-14.

- In the OU 3-13 FS and FS Supplement, the groundwater RAOs were based on achievement of risk-based concentrations or MCLs in the SRPA. This approach is retained for the OU 3-14 FS.

- In the OU 3-13 FS Supplement (DOE-ID 1997a), the groundwater modeling concluded that the I-129 was largely retained in the HI depth interbed at concentrations that exceeded the MCLs. The model theorized that flow of contaminated water from the HI interbed was constrained by the low permeability of the interbed and that a future groundwater user would not be able to extract sufficient water from the interbed alone to sustain a residence. A future groundwater user would have to extract water from the cleaner, more permeable layers above and below the interbed. In the OU 3-14 FS, investigation and sampling of the permeability and other soil properties associated with the HI interbed is included in the OU 3-14 field tasks to assess the viability of the assumption. Groundwater extraction assumptions remain the same: use of a well with a 50-ft screened interval that lies below the top of the water table and delivers water to a receptor at a minimum rate of 0.5 gpm over a 4-hour period.[a]

4.1.2 RCRA/NEPA/CERCLA Integration

The Tank Farm is currently managed under RCRA interim status (LMITCO 1999b). In addition, the draft HLW & FD EIS addresses some of the facilities located within OU 3-14. The EIS compares alternatives for closing the high-level waste facilities and estimates the potential risk posed to the aquifer by implementing the various alternatives for facility closure. While a Tank Farm closure plan has not been finalized and approved at this time, the DOE's intent is to use the following assumptions to help facilitate RCRA/NEPA/CERCLA integration:

- The INTEC Tank Farm is currently under RCRA interim status, and each tank is planned to undergo RCRA closure. The tanks will be included into OU 3-14 as they are closed to ensure a consistent final remedy for the Tank Farm.

- After RCRA closure for the tanks is complete, the impact of the anticipated residuals will be evaluated to the extent they affect cumulative risk. This evaluation of the HWMA/RCRA closed tanks and abandoned piping will occur in accordance with the CEC&C.

- RCRA closure of the Tank Farm is currently expected to include flushing and removing the majority of Tank Farm heels. However, Tank Farm closure could instead include grouting the tank bottom sediment or heels in place, filling the remaining voids in the tanks with either clean or low-level contaminated material and grout, and filling the void space between the tanks and the vaults with either clean or low-level contaminated grout.

- The FS will consider constraints presented by the presence of the Tank Farm vaults, piping, and other components in the soil remediation alternatives. The CERCLA program will not address remediation of the vaults, or tanks, but will address the contaminated and abandoned piping that requires soil excavation prior to removal. The CERCLA program will not address abandoned and contaminated pipes that are in utility corridors that require no or minimal excavation. The RCRA closure program will address contaminated and abandoned piping that is accessible in piping corridors or trenches where excavation is not necessary.

- Capping, containment, in situ treatment, removal, or ex situ treatment of contaminated soil around the Tank Farm cannot be implemented as a final remedy until after the RCRA closure of the Tank Farm has been implemented and deactivation, decontamination, and dismantlement (D&D&D) has removed the adjacent facilities.

---

a. See Idaho "Rules for Public Drinking Water Systems," Section 550, "Design Standards for Public Drinking Water Supply Systems," 16.01.05.550.03.d.i.

- All buildings within the Tank Farm fence that support the Tank Farm operations should be removed by the time CERCLA remediation is implemented. Underground structures, including RCRA-closed tanks that are within the footprint of a cap over the Tank Farm are assumed to be stabilized so that they will not cause unacceptable interference or subsidence of the cap.

- The final decision specified in the OU 3-14 ROD will consider RCRA guidelines.

- The HLW & FD EIS compares alternatives for closing the HLW facilities and estimates the potential risk posed to the aquifer after implementing the various alternatives for facility closure. Modeling conducted in support of the EIS alternative evaluation did not incorporate the contaminated soil in the Tank Farm. Modeling conducted for OU 3-14 will accommodate the Tank Farm tank residuals as a source. The source term used for the Tank Farm residuals will be based on the anticipated end state and residual concentrations as provided in the HLW & FD EIS ROD. Assumptions about content, leak rate, and tank corrosion rate will be obtained from other documents such as the EIS or an approved tank closure plan, when one becomes available.

4.1.3 Investigation-derived Waste Management

Investigation-derived waste will be managed in accordance with the OU 3-14 RI/FS Phase I Work Plan and the Staging and Storage Annex Waste Management Plan. Additional guidance is found in the OU 3-13 ROD, sections 11.1 and 12.2.

4.1.4 Operational Interfaces

The operational interface assumptions listed below are the same as those used in the OU 3-13 FS (DOE-ID 1997b).

- Purge water and well water collected as part of the OU 3-14 investigative activities will be treated, stored and disposed of in a like manner as OU 3-13 Group 4 and Group 5 depending upon contaminant concentration. For planning, it is assumed that the PEW will not be available and that the Staging, Storage, Stabilization, and Treatment Facility (SSSTF) will provide interim and long-term storage for investigation derived wastewater, subject to meeting the WAC.

- As long as the Tank Farm is operational, access is required for the following systems: tank risers, sump risers, valve boxes, relief valve pits, condenser pits, cooling water system, and instrument buildings. Coordination with high-level waste operations would be needed for development of initial phased remedies and remedial alternatives that would be implemented while the Tank Farm is operational to ensure that necessary operational access points are maintained and load restrictions are not exceeded.

- All CERCLA remedial actions are required to conform to a safety analysis envelope in accordance with applicable DOE orders.

- Sites currently inaccessible until the facility preventing access has undergone D&D&D, will be coordinated with programs covering RCRA, operations, or D&D&D, as applicable, for implementation of final remediation. The RCRA closure and D&D&D may include entombment of the facility, which would preclude a potential future removal of underlying contaminated soil. For operating facilities, any activity that may disturb a CERCLA site before CERCLA remediation will be controlled by CERCLA site disturbance notification procedures.

- Water disposal in the existing Percolation Ponds will be discontinued by December 31, 2003. Process water currently being discharged will be discharged to an area that will not hydraulically impact perched water migration within the INTEC.

4.1.5 Tank Farm Closure

The DOE must cease use of five of the 300,000-gal tanks by June 30, 2003, and cease use of the remaining six by December 31, 2012, as specified in *the Second Modification to Consent Order to the Notice of Noncompliance* (DOE-ID 1998) (see Table 1-2). If tank space is needed after these dates, it is assumed that new tanks would be used and these new tanks would be located so that they would not constrain CERCLA remediation of the contaminated soil around the existing tank vaults.

4.1.6 Innovative Technologies

Innovative technologies will be evaluated in the OU 3-14 FS only if they have been successfully demonstrated on similar contaminated media, at a pilot scale or greater, and if they can realistically be expected to be implemented on a full-scale basis. Because remediation may occur many years after the completion of the FS, it is quite possible that new remedial technologies may be developed or refined. Use of technologies other than those analyzed in the FS may be deployed following an "explanation of significant difference" that would be supported by appropriate technical evaluation.

4.1.7 On-Site Consolidation of Contaminated Soil

The Idaho CERCLA Disposal Facility (ICDF) is a planned facility that is being designed to accept radioactive and mixed-waste soil from all INEEL WAGs. The planned size of the ICDF includes provisions for accepting up to half the Tank Farm soil inventory, on the basis of the OU 3-13 RI/FS. Furthermore, the waste acceptance criteria for the ICDF may limit the amount of plutonium-contaminated soil that can be accepted. The ICDF design includes provisions for some reserve capacity; however, if remedial action of Tank Farm soil includes excavation and disposal of large volumes of soil or large inventory of plutonium-contaminated soil, expansion of the ICDF must be considered or other provisions must be made.

4.1.8 Waste Area Group Interfaces

Remedies under the OU 3-14 FS will address risks resulting only from INTEC, or WAG 3, sources. The OU 3-14 FS will not evaluate removal, containment, or treatment of sources from groundwater remediation at other WAGs. The OU 3-13 RI groundwater modeling accounted for contaminants from cross-gradient sources (i.e., the Test Reactor Area [TRA]), and these modeling results were used for the OU 3-13 BRA (DOE-ID 1997a). Based on the OU 3-13 RI, only tritium and chromium from cross-gradient sources were found to intermingle with INTEC contamination. The predicted concentrations of chromium and tritium contamination in the SRPA from the INTEC plus the contribution from TRA for post-2095 are less than the MCLs based on the groundwater modeling performed in the OU 3-13 RI/FS (DOE-ID 1997a, 1997b).

Remediation of the WAG 3 release sites and groundwater is intended to reduce contamination and prevent exposures at WAG 3 but not to specifically mitigate potential groundwater risks at other WAGs in which groundwater risks may be increased because of the addition of WAG 3 source contaminants. The cumulative effects from multi-WAG contaminants in the groundwater will be addressed in WAG 10.

4.1.9 Transuranic Waste

The following assumptions about TRU waste have been made for the OU 3-14 FS:

- Soil sample results show that the release designated as Site CPP-28 may have TRU concentrations greater than 100 nCi/g in the soil.

- The volume of TRU contaminated soil is currently estimate at approximately 459 m^3 (600 yd^3). The only alternative for disposal off the INEEL Site is the Waste Isolation Pilot Plant (WIPP), and it will be available for disposal of WAG 3 CERCLA-generated TRU waste. For the purposes of this FS, the WAG 3 TRU waste will meet the WIPP waste acceptance criteria, the waste will be treatable, or temporary storage at the INEEL is available until alternate disposal options become available.

4.1.10 Long-Term Land Use Assumptions

The following land-use assumptions are adapted from the OU 3-13 BRA (DOE-ID 1997a) and the *Long-Term Land Use Future Scenarios for the Idaho National Engineering Laboratory* (DOE-ID 1995). These assumptions are included in the 3-14 FS Work Plan because the screening and evaluation of remediation alternatives is impacted by the land-use assumptions. The land-use assumptions given in this section are for the FS only.

- No residential development will occur within the industrial corridor of the INEEL before the year 2095.

- The "industrial corridor" of the INEEL will remain under government management for at least 100 years from 1995 (DOE-ID 1995).

- The INEEL Long-Term Land-Use document (DOE-ID 1995) 2095 scenario that limits the INTEC site to "restricted industrial use" will be valid. In 2069 (the 75-year forecast), the INTEC will be in standby mode for restricted industrial use. Reuse is permitted, but no new development will occur outside the existing fence. That status changes to restricted industrial use sometime between 2069 and 2095.

4.1.11 Risk Assessment and Groundwater Modeling Assumptions

The OU 3-14 RI/FS is a focused RI/FS to provide data to complete a FS and select a remedial decision. However, it is anticipated that some risk assessment and groundwater modeling will be required as part of the OU 3-14 RI. The risk from the Tank Farm soil and the SRPA beneath the INTEC fence line has already been agreed to in the OU 3-13 ROD. However, the risk from the Tank Farm soil was made on the basis of many assumptions that will be tested as part of the OU 3-14 investigation. The risk at the INTEC injection well site will likely need to be reevaluated on the basis of the new data collected during Phase I of OU 3-14. In addition, the OU 3-13 RD/RA data collection and activities will provide more detailed data to assess the risk to the groundwater within the INTEC fence line. The additional soil sites from OU 3-13 (Sites CPP-61, CPP-81, and CPP-82) will likely require further risk assessment as a result of the new information gathered in OU 3-14.

It is not possible to foresee the exact needs or objectives required for either the risk assessment or groundwater modeling prior to the completion of the OU 3-14 Phase I sampling activities. Therefore, the approach to both the risk assessment and groundwater modeling will be evaluated pending the results of the OU 3-14 Phase I activities, and a subsequent document will be prepared detailing the approaches to both tasks prior to the start of the OU 3-14 RI/FS Phase II activities. If OU 3-14 BRA or groundwater modeling are necessary, it is anticipated that they will be similar in format to the OU 3-13 BRA or subsequent approaches as negotiated by the DOE-ID, EPA, and IDHW in the OU 3-13 RD/RA.

4.1.12 Other Assumptions

The following is a list of additional assumptions that may apply to OU 3-14:

- The impact of flooding of the Big Lost River will be analyzed during the analysis of feasible remedial alternatives. A 100-year flood scenario will be used. In addition, applicable or relevant and appropriate requirements, such as DOE Order 435.1 will be considered.

- All capping technologies will include a biobarrier to inhibit biotic intrusion into the contamination source.

- If tankage is necessary for processing waste resulting from remedial action, existing tanks will be used whenever technically and economically appropriate.

- Any Tank Farm soil evaluated and classified as TRU waste is directly disposable in WIPP or treatable without the need for TRU treatability studies or nonstandard or remote handling or comply with the alternative requirements in 40 CFR 191 as an ARAR.

- The data to be collected for the OU 3-14 RI/FS will be used, in part, to estimate the nature and extent of contamination of the Tank Farm as a whole. The data collected by implementation of this Work Plan will require supplemental sampling if remediation on a site-by-site basis is found to be appropriate.

- Tank Farm soil, though contaminated with high-level waste, is not classified as high-level waste.

- The risk-based and ARAR-compliance-based decisions about the injection well, Site CPP-23, will be predicated on measured concentrations and trends in the aquifer using existing data and data from new wells.

4.2 Unresolved Issues in the OU 3-13 RI/FS

As stated in Section 1, the OU 3-14 RI/FS (DOE-ID 1997a, 1997b) is being conducted because unresolved issues in the OU 3-13 RI/FS prevented the development of a final remediation plan for the Tank Farm soil; CPP-96; the injection well, CPP-23; and the additional sites outside the Tank Farm, CPP-61, CPP-81, and CPP–82. The unresolved issues remaining from OU 3-13 were discussed in Section 3 and are summarized in the following:

4.2.1 Tank Farm Soil Issues

Tank Farm soil unresolved issues are divided into the following general categories and summarized in this section:

- Nature and extent of contamination

- Contaminant fate and transport

- Contaminant source estimation
- Feasibility study issues.

4.2.2 Issues Relating to the INTEC Injection Well and Aquifer Within the INTEC Fence Line

The INTEC injection well and SRPA within the INTEC fence line unresolved issues involve uncertainties associated with the following:

- Nature and extent of contamination
- Contaminant source estimation
- Feasibility study issues.

4.2.3 Additional Soil Sites from OU 3-13 Issues

The unresolved issues for the additional soil sites from OU 3-13, CPP-61, CPP-81, and CPP-82, are the following:

- Nature and extent of contamination
- Site risk.

4.3 OU 3-14 RI/FS Objectives

The OU 3-14 RI/FS is a planned focused investigation to collect data for the development of a final remedy for the Tank Farm soil, the INTEC injection well and aquifer within the INTEC fenceline, and additional soil sites that were added to the OU 3-14 scope (Sites CPP-61, -81, and -82). Because significant uncertainties were identified during the evaluation of the OU 3-13 FS and the negotiations for the OU 3-13 ROD, these sites were added to the newly created OU 3-14. OU 3-14 was tasked with characterizing these sites to resolve the uncertainty and develop remedial alternatives. Remedial alternative selection process will be completed following the site characterization and risk analysis to determine a final remedial action. In addition to the site characterization data being collected as mentioned above, the following specific needs include defining soil waste types and volumes. The primary objective for the characterization of the three areas is to provide data to identify and evaluate appropriate remedial alternatives.

4.3.1 Tank Farm Soil

The OU 3-13 RI/FS identified major risks from the Tank Farm soil to be external exposure to radiation and ingestion of water from the contaminated SRPA (from contaminants that have been leached from the Tank Farm soil to the SRPA) by future groundwater users. The current information about the nature and extent of contamination from the OU 3-13 RI/FS is inadequate to support the selection of a final remedy for the Tank Farm soil. The OU 3–14 RI/FS will further investigate contamination at the Tank Farm soil through two field investigation phases (Phase I and Phase II) and develop alternatives for a final remedy. Efforts will be undertaken to delineate any leaks/spills that occurred at or near tank vaults. Those identified will be scrutinized to determine what volume may have been short circuited to the underlying basalt.

Phase I will involve field screening of specific analytes (identified in the Tank Farm Field Sampling Plan) to identify analytes of concern, hot spot locations, and the potential for contaminants to migrate to the SRPA. These data will serve to focus Phase II sampling activities toward specific areas of interest. Phase II activities will address soil sampling, moisture monitoring, establishing OU 3-14 COPCs, and detailed questions concerning the identity, concentration, and transport characteristics of specific COPCs. The two-phase approach is proposed as a means to focus project resources on the specific contaminated soil areas that are expected to contribute to groundwater contamination, or that could affect selection of a remedy for the Tank Farm. Specific needs for these two phases include the following:

Field Investigation Phase I

- Define the spatial distribution of gamma-ray-emitting radionuclides by surface and subsurface gross-count gamma-ray surveys.
- Define the spatial distribution, quantities, and concentrations of contaminants, especially plutonium isotopes, in the Tank Farm soil, using laboratory analytical results of soil sampling, to estimate soil volume and waste types requiring remediation.

Field Investigation Phase II

- Collect site-specific soil chemistry
- Research K_d values and collect soil distribution coefficients (K_ds), as necessary, for the OU 3-14 Tank Farm COPCs for use in risk analysis and comparison of the long-term risk reduction needs when evaluating remedial alternatives.
- Provide a better understanding of moisture migration and the contaminant flux through the Tank Farm soil.
- Collect site-specific data to better bound and estimate the total contaminant mass source term in the soil for the contaminant transport simulations to reduce the uncertainty of release estimates to the environment and the risks calculated for the Tank Farm.

4.3.2 INTEC Injection Well and Aquifer within the INTEC Fence Line

The final remedy selection for the SRPA inside the INTEC fence line, including the INTEC injection well, will be made under OU 3-14. The main risk is exposure to radionuclides through ingestion by future groundwater users. Specific needs include the following:

- Provide site-specific soil distribution coefficients (K_ds) for the OU 3-14 COPCs, determined from sampling the injection well (Site CPP-23) and better estimates of contaminant mass source terms in the soil for contaminant transport simulations to reduce the uncertainty of release estimates to the groundwater pathway from the Tank Farm.
- Define the extent, type, and concentration of contaminants at the Site CPP-23 injection well and subsequent secondary sources to define the risk to the SRPA.

4.3.3 Additional Soil Sites from OU 3-13

Several miscellaneous sites were transferred to OU 3-14 from OU 3-13 because the DOE-ID, EPA, and IDHW required further assessment before completing their evaluation. Site CPP-61, a PCB spill, requires a better understanding of the amount of PCB contamination remaining at the site. Sites CPP-81 and CPP-82 require further assessment to develop sufficient data for a final decision. Although these sites may require further evaluation, it is anticipated that a final decision can be reached based on documented historical information. These historical documents will be used, if needed, to scope Phase II.

4.4 OU 3-14 Data Quality Objectives

The objective of OU 3-14 RI/FS Work Plan is to clearly outline and aquifer within the INTEC fence line the data collection activities to be conducted for the OU 3-14 Tank Farm soil, the INTEC injection well, and additional soil sites from OU 3-13 investigations. The activities are being performed to sufficiently characterize the soil and sediment, contaminants, contamination levels, extent of contamination, and soil moisture flux from these sites. The goal of the characterization is to understand the Tank Farm, injection well, and additional soil sites sufficiently to develop appropriate remedial actions that mitigate risk associated with contamination to less than 10E-04 and an IH of less than 1 for human health and the environment.

To help with defensible decision-making, the EPA has developed the data quality objective (DQO) process (EPA 1987), which is a systematic planning tool based on the Scientific Method for establishing criteria for data quality and for developing data collection designs. Data quality objectives have been developed to guide characterization of the Tank Farm soil. The process consists of seven iterative steps that yield a set of principal study questions and decision statements that must be answered to address a primary problem statement. The seven steps composing the DQO process are listed below:

Step 1: State the problem.

Step 2: Identify the decision.

Step 3: Identify the inputs to the decision.

Step 4: Define the study boundaries.

Step 5: Develop decision rules.

Step 6: Specify limits on the decision.

Step 7: Optimize the design for obtaining data.

The DQOs that govern the OU 3-14 investigations are presented in the following sections. The DQO process is an iterative process and the following statements will evolve as the DOE, EPA, and the State of Idaho DEQ provide input. DQOs may also change in response to new site data collected during initial investigations and/or change in work scope.

4.4.1 Tank Farm Data Quality Objectives

The Tank Farm Soil DQOs are presented in the following sections and summarized in Table 4-1. (The table follows the Tank Farm soil DQO section.)

4.4.1.1 DQO STEP 1—State the Problem. The Tank Farm soil is known to be contaminated from historical spills and releases. Information from previous investigations about the nature and extent of the Tank Farm soil contamination is incomplete. The size, location, contaminant type, dose rate, source term, and COPC (OU 3-14 Remedial Investigation determination) migration probability from the site need to be clarified for future remedial actions. The moisture content, contaminant flux out of the Tank Farm soil, and physical, hydraulic, and geochemical soil parameters are required. The OU 3-13 COPCs are those contaminants that have been identified as a potential concern through OU 3-13 RI/BRA. Since the OU 3-13 investigations were not complete, the OU 3-14 sampling will include the preliminary list of potential contaminants identified in the Track 2 Summary Reports for Operable Units 3-07 and 3-08 (WINCO 1993d and 1993b, respectively), from which OU 3-14 COPCs will be determined. The preliminary list of potential contaminants is as follows:

Gross Alpha	Uranium-238	Lead
Gross Beta	Neptunium-237	Manganese
Cobalt-60	Plutonium-238	Mercury
Strontium-90	Plutonium-239	Molybdenum
Technetiurn-99	Plutonium-240	Nickel
Iodine-129	Plutonium-242	Nitrate
Cesium-134	Americium-241	Tetrachloroethylene
Cesium-137	Boron	1,1,1-trichloroethane
Cerium-144	Cadmium	1,1,2-trichloroethane
Uranium-234	Chromium (VI)	Trichloroethylene
Uranium-235	Fluoride	

Background—The Tank Farm soil has become contaminated by spills and pipeline leaks of radioactive liquids from plant and transfer operations. In addition to the known highly contaminated areas, low levels of contamination exist at varying locations and depths. Limited knowledge of the extent (both vertically and horizontally) of contamination, volume of spilled material, types of contaminants, and contamination levels is available because many of the spill sites are in operational and highly radioactive sites. The principal threats posed by contaminated Tank Farm soil is external exposure to radiation and leaching and transport of contaminants to the perched water and eventually to the SRPA where future groundwater users could consume contaminated SRPA groundwater.

The Tank Farm soil is defined as the soil that exist from the surface down to the uppermost basalt flow and include release sites in OU 3-06, 3-07, 3-08, and 3-11. These sites are located within the Tank Farm boundary (Sites CPP-15, CPP -16, CPP-20, CPP-24, CPP-25, CPP-26, CPP-27, CPP-28, CPP -30, CPP-31, CPP-32, CPP-33, CPP-58, and CPP-79), cumulatively known as Site CPP-96. In addition to the contaminants identified during the OU 3-13 RI/BRA, the preliminary COPCs identified during the Track 2 investigations will also be evaluated during the OU 3-14 RI/FS. These contaminants are listed above. These contaminants, combined with the OU 3-13 COPCs, will comprise the complete preliminary OU 3-14 COPCs for this RI/FS.

Radiological OU 3-13 COPCs evaluated in the OU 3-13 ROD and in the OU 3-13 RD/RA include: Am-241, Ce-144,Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Np-237, Pu-238, Pu-239/240, Pu-241, Pu-242, Ru-106, Sr-90, tritium, Tc-99, U-234, U-235, U-236, and zirconium. Known non-radionuclide OU 3-13 COPCs include As, Cr, Hg (mercuric nitrate), nitrate (nitric acid), and thallium. The OU 3-13 ROD showed that Cs-137, Sr-90, and U-235 were a risk to human health (see Section 3.1.4).

Volatile organic compounds and SVOCs were identified as COPCs for release Site CPP-15 during previous OU 3-08 Track 2 investigations (WINCO 1993b), but were screened out as not being a risk concern. Given the type sampling technique being implemented for Phase I Characterization, it is not possible to sample for VOCs and SVOCs at CPP-15 in Phase I. The concern for VOC and SVOC contamination will be addressed as part of the Phase II Characterizations Work Plan. As stated in the Track 2 site evaluation table for Site CPP-15 (WINCO 1993b), "It is known that all radioactively contaminated soil was removed below the solvent tank. Since there was only a possibility for a small amount to have been released to the subsurface and there was not infiltration, due to the building, that should have caused migration, the VOCs would have been removed in association with the radionuclides. Any VOCs which could possibly have remained are not expected to be present due to biodegradation and volatilization of contaminant over the 18-year period since the time of release."

A final CERCLA remedy for the Tank Farm soil release sites has been deferred pending further characterization and coordination of any proposed remedial actions with the Idaho HLW & FDEIS and RCRA closure of the tanks. A separate RI/FS, Proposed Plan, and ROD will be prepared for the Tank Farm soil under OU 3-14. Interim actions were evaluated under the OU 3-13 ROD to provide protection until a final remedy is developed and implemented. The DOE-ID, EPA, and the IDHW have determined that the OU 3-13 interim action will be protective of human health and the environment while the OU 3-14 RI/FS is being performed and a final remedy is selected (DOE-ID 1999a).

For convenience and to facilitate the Tank Farm soil investigations, the soil has been divided into three sections: 0 to 3 m (0 to 10 ft) bgs, 3 to 13.7 m (10 to 45 ft) bgs, and 0 to 13.7 m (0 to 45 ft) bgs. The purposes for the divisions are described below.

- 0 to 3 m (0 to 10 ft) bgs—includes the Tank Farm soil near the surface that poses an external risk and that can reasonably be remediated

- 3 to 13.7 m (10 to 45 ft) bgs—this is the Tank Farm soil that may not be feasible to remediate due to underground tanks and pipes and high radiation levels

- 0 to 13.7 m (0 to 45 ft) bgs—this is the soil that poses a groundwater risk from leaching and from which the total Tank Farm source will be determined.

4.4.1.2 DQO STEP 2—Identify the Decisions. This step of the DQO process lays out the principle study questions, alternative actions, and corresponding decision statements that must be answered to effectively address the above stated problem. The primary decisions involve defining the locations, spacial extent, and concentrations of contaminant releases in the Tank Farm soil, determining contamination mobility, and characterizing the moisture flux moving through the Tank Farm soil. This information is necessary for developing remedial actions that will minimize contamination in the soil from leaching out and eventually being transported to the SRPA.

Principal Study Questions—The purpose of the principal study question (PSQ) is to identify key unknown conditions or unresolved issues that, when answered, provide a solution to the problem being investigated, as stated above. The PSQs for this project are as follows:

PSQ-1a: What is the number and spacial extent of the high contamination zones in the 0 to 3 m (0 to 10 ft) bgs depth range?

PSQ-1b: What is the number and spacial extent of the high contamination zones in the 0 to 13.7 m (0 to 45 ft) bgs depth range? (This is required for the evaluation of groundwater risk and possible remedial alternatives.)

PSQ-2a: What are the radionuclide contaminants in each of the high-contamination zones (from 0 to 13.7 m [0 to 45 ft] bgs)?

PSQ-2b: Are there non-radionuclide contaminants present in the Tank Farm soil from 0 to 13.7 m (0 to 45 ft) bgs (in addition to those currently identified)?

PSQ-3: What is the extent of the mobility of each of the contaminants within each of the identified soil matrices?

PSQ-4a What is the vertical moisture flux moving from the Tank Farm soil into the basalt?

PSQ-4b What is the horizontal moisture flux moving into the Tank Farm soil?

PSQ-5 Based on new data obtained during evaluation of the Tank Farm high contamination zones and soil moisture, what are the best final remedial approaches?

Alternative Actions—Alternative actions (AA) are those actions possible resulting from resolution of the above PSQ's. The types of actions considered will depend on the answers to the PSQ's. Each alternative presents two alternatives (A and B).

AA-1a: A: Data that are needed for evaluation of the external risk and remedial alternatives are available and sufficient to identify affected soil, soil volumes, and concentration levels of contaminated soil for major release sites in the 0 to 3 m (0 to 10 ft) bgs depth at the Tank Farm. Proceed with data collection. (No consequence is associated with this alternative.)

B: Insufficient data or data without high resolution are available and add uncertainty to the identification and quantification of the major Tank Farm high contamination areas. Proceed with gathering more information to make a decision. (The consequence of this alternative is that additional information will be required in order to evaluate remedial technology.)

AA-1b: A: Data that are needed for evaluation of the external risk and remedial alternatives are available and sufficient to identify affected soil, soil volumes, waste types, and concentration levels of contaminated soil for major release sites in the 0 to 13.7 m (0 to 45 ft) bgs depths at the Tank Farm. Calculate a source term for the Tank Farm soil. Proceed with further characterization. (No consequence is associated with this alternative.)

B: Phase I logging data do not have sufficient energy resolution for determining the specific radionuclide(s) generating anomalous gamma radiation. Logging data will only include gross gamma and will not provide speciation. Conduct additional data collection. (The consequence of this alternative is that additional information will be required in order to evaluate remedial technology.)

AA-2a A: The contaminants currently identified are the only radionuclides that are present in the Tank Farm soil that are above risk based action levels and are a potential threat to the SRPA. Proceed with remedial investigation. (No consequence is associated with this alternative.)

B: Other radionuclide contamination, in addition to the OU 3-13 COPCs, are present that are above risk based action levels and could potentially pose a threat to the SRPA. Evaluate all OU 3-14 COPCs to determine contaminated soil volumes, waste types, Tank Farm soil source term, etc. and to determine the appropriate remedial actions. (The consequence of this alternative is that all of the OU 3-14 COPCs need to be identified in order for remedial actions to address them.)

AA-2b A: Mercury, chromium, arsenic, nitrates, and thallium are the only non-radionuclide contaminants in the Tank Farm soil that are above risk based action levels and are identified as OU 3-14 COPCs. Proceed with remedial investigation. (No consequence is associated with this alternative.)

B: Data suggests that other non-radioactive contaminants may be OU 3-14 COPCs. Evaluate all OU 3-14 COPCs to determine contaminated soil volumes, waste types, Tank Farm soil source term for appropriate remedial actions. (The consequence of this alternative is that all of the OU 3-14 COPCs need to be identified in order for remedial actions to address them.)

AA-3 A: Contaminants are strongly sorbed to the Tank Farm soil. Proceed with remedial investigation. (No consequence is associated with this alternative.)

B: Contaminants are mobile and are being or potentially can be leached out of the Tank Farm soil. Evaluate threat and possible need of immediate and appropriate remedial actions. (The consequence is that immediate remediation may be required. This is further discussed in DQO Step 4, Section 4.4.1.4.)

A-4a A: Moisture data indicate there is insignificant flux through the Tank Farm soil to transport contaminants into the basalt, into the perched water and potentially to the SRPA. Proceed with remedial investigation. (No consequence is associated with this alternative.)

B: Moisture data indicate that there is sufficient flux moving through the Tank Farm to transport contaminants to the perched water and subsequently to the SRPA. Evaluate for possible Stage II actions (see Step 4). (The consequence is that if there is significant contaminant flux, immediate remediation may be required.)

AA-4b A: Data indicate there is little moisture moving into the Tank Farm soil horizontally. Proceed with remedial investigation. (No consequence is associated with this alternative.)

B: Moisture data indicate that significant horizontal flux exists in the Tank Farm soil. Evaluate for possible Stage II actions and proceed with investigation. (The consequence is that, if moisture is moving laterally, immediate remedial actions may be required and lateral flux will be a necessary consideration for long-term remedial actions.)

AA-5 A: Data are adequate to characterize the Tank Farm soil, write a RI/FS, and develop appropriate remedial alternatives. Proceed with remedial technology evaluation. (No consequence is associated with this alternative.)

B: There is still too much uncertainty to develop an RI/FS or suggest appropriate remedial actions. Conduct further investigations until there is sufficient understanding to recommend appropriate remedial technology. (The consequence is that more data will be required.)

Decision Statements—The decision statements (DS) combine the PSQ and AA into a concise statement of action. The DS for each of the PSQ's are stated below.

DS-1a: Determine whether the field screening methods have successfully identified all high contamination sites (16 to 23 pCi/g for Cs-137)[a] in the Tank Farm soil (0 to 3 m [0 to 10 ft] bgs) with a volume of $\leq$ 70 ft^3 of soil surrounding the probe hole. This information drives the evaluation of remedial action, technology and design.

DS-1b: Determine whether the field-screening methods have successfully identified all high-contamination sites (16 to 23 pCi/g for Cs-137)[a] from 0 to 13.7 m (0 to 45 ft) bgs in the Tank Farm soil with a volume $\leq$ 70 ft^3 of soil surrounding the probe hole. This information drives the evaluation of remedial technology and design.

DS-2a: Determine whether additional radionuclides in either the soil or soil-pore water are present at concentration levels greater than risk action levels. If so, they will become OU 3-14 COPCs.

DS-2b: Determine whether additional non-radionuclide contaminants are identified in concentrations above risk-based action levels. If so, they will be added to the OU 3-14 COPC list.

DS-3: Determine whether contaminants are being transported out of the Tank Farm soil.

DS-4a: Determine whether the flux out of the soil is stopped by the interim actions. (An additional benefit of moisture characterization may be the identification of major recharge sources.)

DS-4b: Determine whether moisture is moving into the Tank Farm soil (under the temporary cover) from areas outside the Tank Farm.

DS-5: The recommended remedial action will be based on hydraulic, geochemical, and physical drivers, the success of the interim actions, and the comparison of identified requirements, associated technology, and their costs.

4.4.1.3 DQO STEP 3—Identify Inputs to the Decision. This step of the DQO process identifies the informational inputs that are required to answer the decision statements made above.

---

a. This value, arrived at in the coarse of decision actions taken at other NEEL WAG sites, is the concentration of Cs-137 in soil that after 100 years no longer presents any risk.

Inputs for PSQ-1a—PSQ-1a will be answered through a combination of inputs. Primarily, release records along with the gamma survey data will be used to determine the spatial extent of the Tank Farm soil contamination at the 0 to 3 m (0 to 10 ft) bgs. Because the gamma survey will detect only gamma emitters though other radioactive contamination also is likely to be present, a ratio technique will be developed that will predict concentrations of other radioactive contamination potentially present based upon the gamma survey and process knowledge. The input sources for answering the question are the following:

- Historical records
- Process knowledge
- Gamma survey data
- Neutron survey data
- Nuclear constants
- Ratio estimation
- Soil analytical results.

The best available information will serve as the basis for estimating quantities of Cs-137 and other radionuclides. The results will be presented in relative terms only, i.e., the logging detector will no be quantatively calibrated to measure absolute Cs-137 concentration since Phase I is intended as a screening effort only. Relative amounts of other radionuclides may be scaled relative to Cs-137 using radionuclide ratios obtained from one of the following sources:

- Process knowledge concerning the chemistry of the originating waste stream(s), if this can be determined for the release site being examined
- Sample analysis on vacuum excavated soil from the same or nearby probehole.
- The primary purpose of Phase I is to characterize the spatial distribution of gamma- emitting radionuclides as an indicator for overall contamination distribution. Detailed speciation and sampling will be conducted during Phase II, based on Phase I results.

Inputs for PSQ-1b—Contaminant concentrations and locations in the Tank Farm soil from 0 to 13.7 m (0 to 45 ft) bgs will be determined similarly to PSQ-1a.

The input sources for answering PSQ-1b are the following:

- Historical records
- Process knowledge
- Gamma survey data
- Neutron survey data
- Nuclear constants

- Ratio estimation
- Soil analytical results.

Inputs for PSQ-2a—Identification of the radioactive OU 3-14 COPCs for the Tank Farm soil is required to support numerical modeling and development of remedial actions. Development of the OU 3-14 COPCs will rely primarily on the analytical data, field screening data, and model predictions. Information from the following sources is needed.

Inputs sources for answering PSQ-2a are the following:

- Historical records
- Soil analytical data
- Soil-pore water analytical data
- Field screening data
- Risk analysis results
- Model predictions
- Hydraulic properties
- K_d data.

Inputs for PSQ-2b—Information on any non-radioactive contaminants present in the Tank Farm soil is important for modeling considerations and the evaluation of potential remedial actions. Like the radioactive OU 3-14 COPCs, the non-radioactive OU 3-14 COPCs will be based primarily on soil and water analyses but can include input from the following sources.

The inputs to answer PSQ-2b are the following:

- Historical records
- Process knowledge
- Soil analytical data
- Soil-pore water analytical data
- Field screening data
- Risk analysis results
- Model predictions
- Hydraulic properties
- K_d data.

Inputs for PSQ-3—The mobility of contaminants will be determined through selected soil leach and absorption studies. However, input from all of the following sources will be used to determine the potential for the contaminants to be transported from the Tank Farm soil. Potential contaminant mobility will be considered when evaluating remedial alternatives.

- Analytical concentration data
- Selected soil extractions (leach and absorption studies)
- K_d data
- Site-specific geochemistry data
- Model predictions
- Hydraulic properties

Inputs for PSQ-4a—Potential transport of contaminants is a function of two factors: the mobility (addressed in PSQ-3) and the amount of flux that is available to transport contaminants. Moisture content of the Tank Farm soil is directly related to the flux, which can result from recharge sources located either within or above the Tank Farm soil or that are removed from the Tank Farm area. PSQ-4 is concerned with both vertical and horizontal flux. The inputs to answer PSQ-4a will answer the question regarding vertical flux. Vertical flux will be determined by measuring vertical profiles of moisture content and matric potential at locations within the Tank Farm.

The input sources for answering PSQ-4a are the following:

- Vertical profile moisture data
- Vertical profile matric potential data
- Contaminant concentrations
- Model predictions
- Hydraulic property data
- Recharge sources.

Inputs for PSQ-4b. Horizontal flux results from recharge sources located adjacent to the area that is sealed by the Tank Farm membrane (Interim action, DOE-ID 1999b) that may cause water to move laterally through the Tank Farm soil. A horizontal flux can cause contaminants to redistribute in the soil and can promote contaminant transport into the basalts. The existence of horizontal fluxes will be determined by measuring moisture profiles and hydraulic gradients in horizontally spaced stations.

The inputs for answering PSQ-4b are the following:

- Moisture data
- Matric potential data

- Contaminant concentration data
- Model predictions
- Hydraulic property data
- Recharge source.

Inputs for PSQ-5—A decision on PSQ-5 will require characterization of the Tank Farm soil contamination chemistry and hydrology to a sufficient extent that appropriate remedial actions can be selected. Inputs for this decision will include all of the data previously developed. The input sources for answering PSQ-5 include the following:

- Final OU 3-14 Tank Farm soil COPC list
- Concentration levels
- Contaminant flux
- Number of high contamination zones
- Waste volume
- Tank heels
- Recharge water/sources
- Deep drainage
- Site-specific geochemistry
- Hydraulic properties
- Model predictions
- Waste types (e.g. TRU, RCRA, characteristic, TSCA, and mixed)
- Remedial cost
- Impracticability of technology
- Technical feasibility, maturity, and efficacy of remedial technology
- Source term for the Tank Farm soil
- Source term for the Tank Farm soil and closed tanks combined.

4.4.1.4 DQO STEP 4—Define the Boundaries of the Study. This study focuses on sufficiently characterizing the Tank Farm soil to understand the contamination types, levels, distribution, associated risks, and area hydrology and geochemistry for the purpose of identifying effective remedial actions for the OU3-14 RI/FS, proposed plan, and ROD.

Specifically included in this study is the contamination in the surface soil (from the surface to top of basalt) at the Tank Farm. The physical boundaries of the study are the Tank Farm area known as Site CPP-96. Site CPP-96 includes CPP-15, CPP-16, CPP-20, CPP-24, CPP-25, CPP-26, CPP-27, CPP-28, CPP-30, CPP-31, CPP-32, CPP-33, CPP-58 and CPP–79. These are all the sites within the Tank Farm or adjacent to the PEW evaporator building. At depth, the boundaries of the study area are from the surface to the top of basalt. This depth varies with location but averages about 13.7 m (45 ft).

The OU 3-14 RI/FS Investigation activities are anticipated to occur over six years, with two field investigations. Boundaries on the stages are shown below:

- Field Investigation Phase I: Gamma Radiation Field Screening and soil sampling
- Field Investigation Phase II: Soil Sampling and Moisture Monitoring
- Contaminant Transport and Treatability Studies
- Risk Assessment and Groundwater Modeling
- RI/FS Report
- OU 3-14 ROD Preparation

The OU 3-14 Post-Record of Decision Tank Farm remedial activities are anticipated to be undertaken in four stages timed to accommodate facility RCRA closure. Boundaries on the stages are shown below:

- Stage I: Moisture monitoring and control
- Stage II: Address immediate threats during Tank Farm operations and RCRA closure of some high level waste tanks
- Stage III: Begin remediation of post-RCRA closure of the high level waste tanks but before D&D&D of the surrounding area and buildings
- Stage IV: Final remedy for the Tank Farm area after all INTEC D&D&D activities are complete.

In addition to the physical and time boundaries, shown above, other boundaries (listed below) could possibly impact the project.

Schedule boundaries: The schedule may be impacted by the budget allotted to the remedial action. Any loss in the budget without adjustment in scope will extend the schedule. That action may adversely impact the mitigation of the transport of contaminants to the SRPA.

Budget boundaries: The budget is anticipated to remain at a constant funding level during the course of the project (1.8 M/year from FY-2001 through FY-2006 for both the Tank Farm soil and the injection well investigations). This will require that remedial actions be optimized not only technically but also financially.

Concentration boundaries: These boundaries result from contaminant concentrations. For radionuclide concentrations the boundaries extend from low concentrations to the risk-based action levels agreed to in the OU 3-13 ROD. A high dose rate could drive remote remedial methods. Other remedial considerations related to concentration levels include upper inventory levels of possible waste disposal facilities. Metals concentration levels should not impact remedial activities. Should high volatile organic compound (VOC) levels be present, some remedial activities could be affected (e.g., grout and thermal processes).

Moisture boundaries: Moisture boundaries with the potential to impact the OU 3-14 investigation and remediation are only on the high side. Saturated moisture conditions mandate immediate action. Conditions probably can not become too dry.

Operational boundaries: The remediation of the Tank Farm soil will occur in remedial stages (shown above) to cooperate and not interfere with operational activities. Activities in each stage could be impacted by ongoing operations.

Treatment evaluation boundaries: The evaluation of remedial technologies may potentially be impacted by a variety of laboratory-related influences including scale, contamination levels, and heterogeneity. It also may be impacted by the maturity of the treatment.

Integration boundaries: Final remediation may be impacted by the integration of any or all of the above boundaries.

4.4.1.5 DQO STEP 5—Develop a Decision Rule. This step of the DQO process brings together the outputs from Steps 1 through 4 into a single statement describing the basis for choosing among the listed alternatives.

- Decision Rule (DR)-1a: If high resolution data are available and sufficient to identify affected soil, soil volumes, and concentration levels of contaminated soil for all major release sites in the 0 to 3 m (0 to 10 ft) bgs depths at the Tank Farm then proceed with AA-1a A. If not, proceed with AA-1a B.

- DR-1b: If high resolution data are available and sufficient to identify affected soil, soil volumes, waste types, and concentration levels of contaminated soil for major release sites in the 0 to 13.7 m (0 to 45 ft) bgs depths at Tank Farm, proceed with AA-1b A. If not, proceed with AA-1b B.

- DR-2a: If OU 3-13 COPCs are the only radionuclides that are present in the Tank Farm soil that are above risk based action levels and are a potential threat to the SRPA and they become OU 3-14 COPCs, proceed with AA-2a A. Otherwise proceed with AA-2a B.

- DR-2b: If Hg, Cr, As, Th, and nitrates are the only non-radionuclide contaminants in the Tank Farm soil that are above risk based action levels and are identified, and they become OU 3-14 COPCs, then proceed with AA-2b A. Otherwise, proceed with AA-2b B.

- DR-3: If contaminants are strongly sorbed to the Tank Farm soil, then proceed with AA-3 A. Otherwise, proceed with AA-3 B.

- DR-4a: If moisture data indicate there is insignificant flux through the Tank Farm soil to transport contaminants down to the perched water and potentially to the SRPA, then proceed with AA-4a A. Otherwise, proceed with AA-4a B.

- DR-4b: If data indicates there is not significant moisture moving into the Tank Farm Soil laterally, then proceed with AA-4b A. Otherwise, proceed with AA-4b B.

- DR-5: If data are adequate to characterize the Tank Farm soil, write a RI/FS, and develop appropriate remedial AAs, then proceed with AA-5 A. Otherwise, proceed with AA-5 B.

4.4.1.6 DQO STEP 6—Specify Tolerable Limits on Decision Errors. This step of the DQO process sets out the acceptable limits on decision errors. These limits are used to establish performance goals for the data collection design.

Data collected to determine whether additional contaminants in the Tank Farm soil are at concentration levels equal to or greater than risk-based action levels (DS-2a and DS-2b) are amenable to statistically based limits on decision errors. Hypothesis testing will be utilized to determine if action levels are exceeded to resolve Principal Study Questions 2a and 2b (PSQ-2a and PSQ-2b). The null hypothesis, H_0, is that the true mean of a contaminant is greater than or equal to the risk-based action level. The alternative is that the true mean is less than the risk-based action level.

- H_0: $\mu \geq$ action level

- H_a: $\mu <$ action level

The hypothesis testing will be performed to a level of significance, α, of 0.05. In other words, with this level of significance, we limit the probability of a Type I error, or of rejecting the null hypothesis when it is true, to 5%. The hypothesis testing is designed to allow us to control the probability or erroneously concluding that action levels are not exceeded when in fact they are exceeded. The null hypothesis was formulated based upon the belief that the harmful consequences of incorrectly concluding that an action level is not exceeded when it actually is exceeded outweigh the consequences of incorrectly concluding that the action level is exceeded when in fact it is not.

Statistically based decision errors are not appropriate for the other decision statements.

4.4.1.7 DQO STEP 7—Optimize the Design. The information necessary to evaluate remedial alternatives and develop the feasibility study will be obtained from the site characterization and, if deemed necessary, treatability and contaminant transport studies. A final decision will be made in the OU 3-14 ROD. It is envisioned that four stages will occur, following the OU 3-14 Tank Farm Field Investigation Phases, I and II, and the OU 3-14 ROD.

Stage I. Activities included in this stage will focus on moisture monitoring and control. It is during this stage that the Phase I characterization activities will occur, in addition to the OU 3-13 Tank Farm Interim Action. Phase I activities include: the surface geophysics/gamma surveys, installation of the probeholes, gamma logging of the probeholes, and direct sampling of selected vacuumed soil stored in drums from the probehole installation activities. Technical papers to be prepared during Phase I include: Phase I data summary report and a remedial alternative screening report.

Stage II. During this stage immediate threats during Tank Farm operations and RCRA closure of some high level waste tanks will be addressed. During this stage, Phase II characterization will be implemented, along with continuing the OU 3-13 Tank Farm Interim Action. Phase II involves conducting a more detailed soil gamma survey, and potentially collecting soil samples from specific areas, i.e., hot spots, to characterize contaminants, waste types, and source terms. This would involve the installation of large-diameter probe holes and moisture monitoring stations, initiation of moisture monitoring, and contaminant mobility studies. If deemed necessary, treatability studies may also be initiated during this phase, which would evaluate in situ stabilization, grouting, and other technologies that are under consideration. Technical papers to be prepared during Phase II include: Phase II data summary report, contaminant transport study report, risk assessment strategy, groundwater strategy, conceptual model report, RI/BRA report, treatability study report (if treatability studies are performed), and a feasibility study report.

Stage III. During this stage remediation of post-RCRA closure of the high-level waste-tanks will began, in addition to continuing the OU 3-13 Tank Farm Interim Action. This stage will occur before D&D&D of the surrounding area and buildings.

Stage IV. Activities in this stage include the final remedy (compatible with the OU 3-13 Tank Farm Interim Action) for the Tank Farm area after all INTEC D&D&D activities are complete.

4.4.2 INTEC Injection Well and Aquifer Within the INTEC Fence Line

The following sections discuss the DQOs developed to govern the injection well investigation. The DQOs developed for the INTEC injection well are summarized in Table 4-2 (The table follows the DQO section).

4.4.2.1 DQO STEP 1—State the Problem. The potential problem involving the SRPA inside the INTEC fence line, the injection well and involves uncertainty in characterizing the residual contamination resulting from its use. The injection well is known to have injected contaminated fluids into the SRPA. A 37-m (120-ft) sediment column has built up inside casing. The sediment is thought to be either an accumulation of materials that were suspended in the wastewater or sediment that caved in from the well sides during periods of well repair. The volume of residual contamination is not well characterized, as are the specific contaminants, their amounts, concentrations, and mobility. There is also uncertainty regarding the potential for residual contamination in the sediment and SRPA materials to become a secondary source of contamination to the SRPA.

The Track 2 Summary Report for CPP-23 CPP Injection Well (1994), Comprehensive RI/FS for OU 3-13 at the INEEL – Part A, RI/BRA Report (DOE-ID 1997) and the OU 3-13 Record of Decision (DOE-ID 1999) identified several contaminants that may have been discharged to the injection well. Based on these reports, the contaminants of potential concern (COPCs) for the injection well include I-129, Sr-90, Pu-isotopes, H-3, Am-241, Tc-99, Cs-137, Co-60, Eu-152/-154, arsenic, chromium, mercury, nitrate/nitrite, and osmium. In addition, the injection well has completed RCRA closure as described in the Final Closure Plan for LDU CPP-23 Injection Well (MAH-FE-PL-304) (DOE-ID 1990). In Section 2.1 of this closure plan, it states that "The only known contaminant release to the well identified as a RCRA concern is the mercury release which occurred in March 1981."

As part of the closure effort, a sediment sample was collected from the injection well by the USGS on August 31, 1989 and analyzed for 40 CFR 261 Appendix VIII hazardous constituents, for which EPA-approved methods exist. Analyses of the sediment sample detected traces of metals, radioactivity, and PCBs. No organic compounds, other than PCBs, were detected in the sediment sample from the injection well. The closure plan also required the collection and Appendix VIII analysis groundwater samples from the adjacent wells (USGS-40 and USGS-47) and the production well (Production Well #1). Theses results also did not detect organic compounds in the groundwater.

Table 4-1. OU 3-14 Tank Farm soil DQOs.

1: State the Problem	2: Identify the Decision			3: Identify Inputs to the Decision	4: Define the Study Boundaries
Background: The Tank Farm soil has become contaminated by spills and pipeline leaks of radioactive liquids from plant and transfer operations. In addition to the known highly contaminated areas, low levels of contamination exist at varying locations and depths. Limited knowledge of the extent (both vertically and horizontally) of contamination, volume of spilled material, types of contaminants, and contamination levels is available because many of the spill sites are in operational and highly radioactive sites. The principal threats posed by contaminated Tank Farm soil is external exposure to radiation and leaching and transport of contaminants to the perched water SRPA where future groundwater users could consume contaminated SRPA groundwater. The Tank Farm soil are defined as the soil that exist from the surface down to the uppermost basalt flow and include release sites in OU 3-06, 3-07, 3-08, and 3-11. These sites are located within the Tank Farm boundary (Sites CPP-15, CPP -16, CPP-20, CPP-24, CPP-25, CPP-26, CPP-27, CPP-28, CPP -30, CPP-31, CPP-32, CPP-33, CPP-58, and CPP–79), cumulatively known as Site CPP-96. Contaminants of potential concern (OU 3-13 COPCs) evaluated in the OU 3-13 ROD or in the OU 3-13 RD/RA include: Am-241,Ce-144, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Np-237, Pu-238, Pu-239/240 , Pu-241, Pu-242, Ru-106, Sr-90, tritium, Tc-99, U-234, U-235, U-236, and zirconium. Known non-radionuclide contaminants include As, Cr, Hg (mercuric nitrate), nitrate (nitric acid), and thallium. The OU 3-13 ROD showed that Cs-137, Sr-90, and U-235 were a risk to human health. Volatile organic compounds and SVOCs were identified as COPCs for release Site CPP-15 during previous OU 3-08 Track 2 investigations (WINCO 1993b), but were screened out as not being a risk concern. Given the type of sampling technique being implemented for Phase I Characterization, it is not possible to sample for VOCs and SVOCs at CPP-15 in Phase I. The concern for VOC and SVOC contamination will be addressed as part of the Phase II Characterization Work Plan. A final CERCLA remedy for the Tank Farm soil release sites has been deferred pending further characterization and coordination of any proposed remedial actions with the Idaho HLW & FD EIS and RCRA closure of the tanks. A separate RI/FS, Proposed Plan, and ROD will be prepared for the Tank Farm soil under OU 3-14. Interim actions were evaluated under the OU 3-13 ROD to provide protection until a final remedy is developed and implemented. The DOE-ID, EPA, and the IDHW have determined that the OU 3-13 interim action will be protective of human health and the environment while the WAG 3 OU3-14 RI/FS is being performed and a final remedy is selected (DOE-ID 1999b). For convenience and to facilitate the Tank Farm soil investigations, the soil have been divided into three sections: 0 to 3 m (0 to 10 ft bgs), 3 to 13.7 m (10 to 45 ft bgs), and 0 to 13.7 m (0 to 45 ft bgs). The purpose for the divisions are described below. .3 m (0 to 10 ft bgs)—includes the Tank Farm soil near the surface that can reasonably be remediated 3 to 13.7 m (10 to 45 ft bgs)—these are the Tank Farm soil that may not be feasible to remediate due to underground tanks and pipes and high radiation levels 3–13.7 m (0 to 45 ft bgs)—these are the soil from which the total Tank Farm source will be determined. Because the Tank Farm is an operational facility, future leaks and spills are possible.	Success at meeting the remedial action objective will be determined by obtaining sufficient characterization data to develop a RI/FS, proposed plan, and ROD from which a remedial action can be selected that will prevent contaminants in the Tank Farm soil from being leached down to the perched water and possibly contaminating the SRPA.				This study focuses on sufficiently characterizing the Tank Farm soil to understand the contamination types, levels, and distribution and the risks associated with the contamination, the areal hydrology, and the geochemistry for the purpose of identifying effective remedial actions for the OU3-14 RI/FS, proposed plan, and ROD. Specifically included in this study is the contamination in the surface soil (from the surface to top of basalt) at the Tank Farm. The physical boundaries of the study are the Tank Farm area known as Site CPP-96. Site CPP-96 includes CPP-15, CPP-16, CPP-20, CPP-24, CPP-25, CPP-26, CPP-27, CPP-28, CPP-30, CPP-31, CPP-32, CPP-33, CPP-58 and CPP–79. These are all the sites within the Tank Farm or adjacent to the PEW evaporator building. The boundary is defined in the OU 3-14 Scope of Work (DOE-ID 1999a). At depth, the boundaries of the study area are from the surface to the top of basalt. This depth varies with location but averages about 13.7 m (45 ft). OU 3-14 Characterization Investigation activities: • Field Investigation Phase I • Field Investigation Phase II • Contaminant Transport and Treatability Studies • Risk Assessment and Groundwater Modeling • RI/FS Report • OU 3-14 ROD Preparation The Post-ROD OU 3-14 Tank Farm remedial activities are anticipated to be undertaken in four stages timed to accommodate facility RCRA closure. Boundaries on the stages are shown below. • Stage I: Moisture monitoring and control • Stage II: Address immediate threats during Tank Farm operations and RCRA closure of some high level waste tanks • Stage III: Begin remediation of post-RCRA closure of the high level waste tanks but before D&D&D of the surrounding area and buildings • Stage IV: Final remedy for the Tank Farm area after all INTEC D&D&D activities are complete. Site characterization is anticipated to be initiated in two phases. In addition to the physical and time boundaries, shown above, other boundaries (listed below) could possibly impact the project. *Schedule boundaries:* The schedule may be impacted by the budget allotted for the remedial action. Any loss in the budget without adjustment in scope will extend the schedule. That action may adversely impact the mitigation of the transport of contaminants to the SRPA. *Budget boundaries:* The budget is anticipated to remain at a constant funding level during the course of the investigation. This will require that remedial actions be optimized not only technically but also financially.
	Principal Study Questions	Alternative Actions	Decision Statement		
	PSQ-1a: What is the number and spatial extent of the high contamination zones in the 0 to 3 m (0 to 10-ft) depth range? (This is required for evaluation of the residential and external risk and possible remedial alternatives.)	A: High-resolution data that are needed for evaluation of the external risk and remedial alternatives are available and sufficient to identify affected soil, soil volumes, and concentration levels of contaminated soil for major release sites in the 0 to 10-ft depth at the Tank Farm. Proceed with data collection. (No consequence is associated with this alternative.) B: Insufficient data or data without high resolution are available and add uncertainty to the identification and quantification of the major Tank Farm high-contamination areas. Proceed with gathering more information to make decision. (The consequence of this alternative is that additional information will be required in order to evaluate remedial technology.)	DS-1a: Determine whether the field screening methods have successfully identified all high contamination sites (16 to 23 pCi/g for Cs-137) in the Tank Farm soil 0 to 3 m (0 to 10 ft bgs) with a volume of ≤ 70 ft^3 of soil surrounding the probe hole. This information drives the evaluation of remedial technology and design.	Inputs to the PSQ-1a decision include: Historical records Process knowledge Gamma survey data Neutron survey data Nuclear constants Ratio estimation Soil analytical results	
	PSQ-1b: What is the number and spatial extent of the high contamination zones in the 0 to 13.7 m (0 to 45-ft) depth range? (This is required for the evaluation of groundwater risk and possible remedial alternatives.)	A: High resolution data that are needed for evaluation of the external risk and remedial alternatives are available and sufficient to identify affected soil, soil volumes, waste types, and concentration levels of contaminated soil for major release sites in the 0 to 45 ft depths at the Tank Farm. Calculate a source term for the Tank Farm soil. Proceed with further characterization. (No consequence is associated with this alternative.) B: Insufficient data or data without high resolution are available and add uncertainty to the identification and quantification of the major Tank Farm high contamination areas. Conduct additional data collection. (The consequence of this alternative is that additional information will be required in order to evaluate remedial technology.)	DS-1b: Determine whether the field-screening methods have successfully identified all high-contamination sites (16 to 23 pCi/g for Cs-137) from 0 to 13.7 m (0 to 45 ft bgs) in the Tank Farm soil with a volume ≤ 70 ft^3 of soil surrounding the probe hole. This information drives the evaluation of remedial technology and design.	Inputs to the PSQ-1b decision include: Historical records Process knowledge Gamma survey data Neutron survey data Nuclear constants Ratio estimation Soil analytical results	
	PSQ-2a: What are the radionuclide contaminants in each of the high contamination zones (from 0 to 13.7 m [0 to 45 ft bgs])?	A: The contaminants currently identified are the only radionuclides that are present in the Tank Farm soil that are above risk based action levels (OU 3-13 COPCs) and are a potential threat to the SRPA. Proceed with remedial investigation. (No consequence is associated with this alternative.) B: Other radionuclide contamination, in addition to the OU 3-13 COPCs, are present that are above risk based action levels and could potentially pose a threat to the SRPA. Evaluate all OU 3-14 COPCs to determine contaminated soil volumes, waste types, Tank Farm soil source term, etc. and to determine the appropriate remedial actions. (The consequence of this alternative is that all of the OU 3-14 COPCs need to be identified in order for remedial actions to address them.)	DS-2a: Determine whether additional radionuclides in either the soil or soil-pore water are present at concentration levels greater than risk action levels. If so, they will become OU 3-14 COPCs.	Inputs to the PSQ-2a decision include Historical records Soil analytical data Soil-pore water analytical data Field screening data Risk analysis results Model predictions Hydraulic properties K_d data	
	PSQ-2b: Are there non-radionuclide contaminants present in the Tank Farm soil from 0 to 45 ft bgs (in addition to those currently identified)?	A: Mercury, chromium, arsenic, thallium, and nitrates are the only non-radionuclide contaminants in the Tank Farm soil that are above risk based action levels and are identified as OU 3-14 COPCs. Proceed with remedial investigation. (No consequence is associated with this alternative.) B: Data suggests that other non-radioactive contaminants may become OU 3-14 COPCs. Evaluate all OU 3-14 COPCs to determine contaminated soil volumes, waste types, Tank Farm soil source term, etc. and for appropriate remedial actions. (The consequence of this alternative is that all of the OU 3-14 COPCs need to be identified in order for remedial actions to address them.)	DS-2b: Determine whether additional non-radionuclide contaminants are identified in concentrations above risk-based action levels. If so, they will be added to the OU 3-14 COPC list for the Tank Farm soil.	Inputs to the PSQ-2b include Historical records Process knowledge Soil analytical data Soil-pore water analytical data Field screening data Risk analysis results Model predictions Hydraulic properties K_d data	
	PSQ-3: What is the extent of the mobility of each of the contaminants within each of the identified soil matrices??	A: Contaminants are strongly sorbed to the Tank Farm soil. Proceed with remedial investigation. (No consequence.) B: Contaminants are mobile and are being or potentially can be leached out of the Tank Farm soil. Evaluate the threat and possible need of immediate and appropriate remedial actions. (The consequence is that immediate remediation may be required.)	DS-3: Determine whether contaminants are being transported out of the Tank Farm soil.	Inputs to the PSQ-3 decision include: Analytical concentration data Selected soil extractions (leach and absorption studies) K_d data Site-specific geochemistry Model predictions Hydraulic properties	
	PSQ-4a: What is the vertical moisture flux moving from the Tank Farm soil into the basalt?	A: Moisture data indicate there is insignificant flux through the Tank Farm soil to transport contaminants into the basalt, into the perched water and potentially to the SRPA. Proceed with remedial investigation. (No consequence is associated with this alternative.) B: Moisture data indicate that there is enough flux moving through the Tank Farm to transport contaminants to the perched water and potentially to the SRPA. Evaluate for possible Stage II actions. (The consequence is that if there is significant OU 3-14 COPC flux, immediate remediation may be required.).	DS-4a: Determine whether the flux out of the soil is stopped by the interim actions. (An additional benefit of moisture characterization may be the identification of major recharge sources.)	Inputs to the PSQ-4a decision include: Moisture data Matric potential data Contaminant concentrations Model predictions Hydraulic property data Recharge sources	
	PSQ-4b: What is the horizontal moisture flux into the Tank Farm soil?	A: Data indicate there is little moisture moving into the Tank Farm soil horizontally. Proceed with remedial investigation. (No consequence is associated with this alternative.) B: Moisture data indicates that a significant lateral flux exists in the Tank Farm soil. Evaluate for possible Stage II actions and proceed with investigation. (The consequence is that if moisture is moving laterally, immediate remedial actions may be required and lateral flux will be a necessary consideration for long-term remedial actions.).	DS-4b: Determine whether moisture is moving into the Tank Farm soil (under the temporary cover) from areas outside the Tank Farm.	Inputs to the PSQ-4b decision include: Moisture data Matric potential data Contaminant concentration data Model predictions Hydraulic property data Recharge source K_d data	

Table 4-1. (continued).

1: State the Problem	2: Identify the Decision			3: Identify Inputs to the Decision	4: Define the Study Boundaries
Problem Statement: The Tank Farm soil is known to be contaminated from historical spills and releases. Information from previous investigations about the nature and extent of the Tank Farm soil contamination is incomplete. The size, location, contaminant type, dose rate, source term, and OU 3-14 COPC (OU 3-14 Remedial Investigation determination) migration probability from the site need to be clarified for future remedial actions. The moisture content, contaminant flux out of the Tank Farm soil, and physical, hydraulic, and geochemical soil parameters are required.	PSQ-5 Based upon new data obtained during evaluation of the Tank Farm high contamination zones and soil moisture, what are the best final remedial approaches?	A: Data are sufficient to characterize the Tank Farm soil, write a RI/FS, and develop appropriate remedial alternatives. Proceed with remedial technology evaluation. (No consequence.) B: There is still too much uncertainty to develop an RI/FS or suggest appropriate remedial actions. Conduct further investigations until understanding is sufficient to recommend appropriate remedial technology. (The consequence is that more data will be required.)	DS-5: The recommended remedial action will be based on hydraulic, geochemical, and physical drivers; the success of the interim actions; and the comparison of the identified requirements, associated technologies, and their cost.	Inputs to the PSQ-5 decision include: Final OU 3-14 Tank Farm soil COPC list Concentration levels Contaminant flux Number of high contamination zones Waste volume Tank heels Recharge water/sources Site-specific geochemistry data Deep drainage Hydraulic properties Model predictions Waste types (TRU, RCRA, characteristic, TSCA, mixed, etc.) Remedial cost Impracticability of technology Technical feasibility of remediation technology Maturity of technology Efficacy of technology Source term for Tank Farm soil Source term for Tank Farm soil and closed tanks	*Moisture boundaries:* Moisture boundaries with the potential to impact the OU 3-14 investigation and remediation are only on the high side. Saturated moisture conditions mandate immediate action. The soil cannot become too dry. *Concentration boundaries:* These boundaries result from contaminant concentrations. For radionuclide concentrations the boundaries extend from low concentrations to the risk-based action levels agreed to in the OU 3-13 ROD. A high dose rate could drive remote remedial methods. Other remedial considerations related to concentration levels include upper inventory levels of possible waste disposal facilities. Metals concentration levels should not impact remedial activities. Should high VOC levels be present, some remedial activities could be affected, e.g., grout and thermal processes. *Operational boundaries:* The remediation of the Tank Farm soil will occur in stages (shown above) to cooperate and not interfere with operational activities. Activities in each stage of remediation could be impacted by ongoing operations. *Treatment evaluation boundaries:* The evaluation of remedial technologies may potentially be impacted by a variety of laboratory-related influences including scale, contamination levels, and heterogeneity. It may also be impacted by the implementability of the treatment. *Integration boundaries:* Final remediation may be impacted by the integration of any or all of the above boundaries.

Table 4-1. (continued).

<table>
<tr><th>5: Develop a Decision Rule</th><th>6: Specify Tolerable Limits on Decision Errors</th><th>7: Optimize the Design</th></tr>
<tr><td>DR-1a: If high resolution data are available and sufficient to identify affected soil, soil volumes, and concentration levels of contaminated soil for all major release sites in the 0 to 3 m (0 to 10-ft) depths at the Tank Farm then proceed with Alternative A. If not, proceed with Alternative B.</td>
<td rowspan="9">Data collected to determine whether additional contaminants in the Tank Farm soil are at concentration levels equal to or greater than risk-based action levels (DS-2a and DS-2b) are amenable to statistically based limits on decision errors. Hypothesis testing will be utilized to determine if action levels are exceeded to resolve Principal Study Questions 2a and 2b (PSQ-2a and PSQ-2b).

The null hypothesis, H_0, is that the true mean of a contaminant is greater than or equal to the risk-based action level. The alternative is that the true mean is less than the risk-based action level.

H_0: $\mu \geq$ action level
H_a: $\mu <$ action level

The hypothesis testing will be performed to a level of significance, α, of 0.05. In other words, with this level of significance, we limit the probability of a Type I error, or of rejecting the null hypothesis when it is true, to 5%. The hypothesis testing is designed to allow us to control the probability or erroneously concluding that action levels are not exceeded when in fact they are exceeded. The null hypothesis was formulated based upon the belief that the harmful consequences of incorrectly concluding that an action level is not exceeded when it actually is exceeded outweigh the consequences of incorrectly concluding that the action level is exceeded when in fact it is not.

Statistically based decision errors are not appropriate for the other decision statements.</td>
<td rowspan="9">The information necessary to evaluate remedial alternatives and develop the feasibility study will be obtained from the site characterization and, if deemed necessary, treatability and contaminant transport studies. A final decision will be made in the OU 3-14 ROD. It is envisioned that four stages of Post-OU 3-14 ROD remedial activities will occur.

Stage I. Activities included in Stage I will focus on moisture monitoring and control. It is during this stage that the Phase I characterization activities will occur, in addition to the OU 3-13 Tank Farm Interim Action. Phase I activities include: the surface geophysics/gamma surveys, installation of the probeholes, gamma logging of the probeholes, and direct sampling of selected vacuumed soil stored in drums from the probehole installation activities. Technical papers to be prepared during Phase I include: Phase I data summary report and a remedial alternative screening report.

Stage II. During Stage II immediate threats during Tank Farm operations and RCRA closure of some high level waste tanks will be addressed. During this stage, Phase II characterization will be implemented, along with continuing the OU 3-13 Tank Farm Interim Action. Phase II involves conducting a more detailed soil gamma survey, and potentially collecting soil samples from specific areas, i.e., hot spots, to characterize contaminants, waste types, and source terms. This would involve the installation of large-diameter probe holes and moisture monitoring stations, initiation of moisture monitoring, and contaminant mobility studies. If deemed necessary, treatability studies may also be initiated during this phase, which would evaluate in situ stabilization, grouting, and other technologies that are under consideration. Technical papers to be prepared during Phase II include: Phase II data summary report, contaminant transport study report, risk assessment strategy, groundwater strategy, conceptual model report, RI/BRA report, treatability study report (if treatability studies are performed), and a feasibility study report.

Stage III. During Stage III, remediation of post-RCRA closure of the high-level waste-tanks will began, in addition to continuing the OU 3-13 Tank Farm Interim Action. This stage will occur before D&D&D of the surrounding area and buildings.

Stage IV. Activities in Stage IV include the final remedy (compatible with the OU 3-13 Tank Farm Interim Action) for the Tank Farm area after all INTEC D&D&D activities are complete.</td></tr>
<tr><td>DR-1b: If high resolution data are available and sufficient to identify affected soil, soil volumes, waste types, and concentration levels of contaminated soil for major release sites in the 0 to 13.7 m (0 to 45-ft) depths at Tank Farm, proceed with Alternative A. If not, proceed with Alternative B.</td></tr>
<tr><td>DR-2a: If contaminants currently identified are the only radionuclides that are present in the Tank Farm soil that are above risk based action levels and are a potential threat to the SRPA, proceed with Alternative A. Otherwise proceed with Alternative B.</td></tr>
<tr><td>DR-2b: If Hg, Cr, As, and nitrates are the only non-radionculide contaminants in the Tank Farm soil that are above risk based action levels and are identified as OU 3-14 COPCs, then proceed with Alternative A. Otherwise, proceed with Alternative B.</td></tr>
<tr><td>DR-3: If contaminants are strongly sorbed to the Tank Farm soil, then proceed with Alternative A. Otherwise, proceed with Alternative B.</td></tr>
<tr><td>DR-4a: If moisture data indicate there is insignificant flux through the Tank Farm soil to transport contaminants down to the perched water and potentially to the SRPA, then proceed with Alternative A. Otherwise, proceed with Alternative B.</td></tr>
<tr><td>DR-4b: If data indicates there is not significant moisture moving into the Tank Farm soil laterally, then proceed with Alternative A. Otherwise, proceed with Alternative B.</td></tr>
<tr><td>DR-5: If there is enough data to characterize the Tank Farm soil, write a RI/FS, and develop appropriate remedial alternatives, then proceed with Alternative A. Otherwise, proceed with Alternative B.</td></tr>
</table>

Based upon these results, it appears that the COPCs for the injection well consist of radionuclides, metals, and PCBs. For completeness and to address possible uncertainities, the sediments from the injection well will also be sampled for the nine listed waste constituents previously identified at INTEC (benzene, carbon disulfide, carbon tetrachloride, hydrogen fluoride, pyridine, tetrachlorethylene, toluene, 1,1,1-trichloroethane, and trichloroethylene). In addition, the following constituents (acetone, cyclohexane, cyclohexanone, ethyl acetate, methanol, methyl isobutyl ketone, and xylene) were identified to be present in INTEC waste streams (INEEL/EXT-98-01212, revision 1, February 1999).

***Background Summary*—**A brief summary of the injection well also known as (Site-23) background is presented. The history of the Chemical Processing Plant (CPP)-23, the former INTEC injection well, was initially drilled in 1950 to a depth of 65 m (212 ft) bgs and abandoned. In 1952, the borehole was cleaned out and deepened to a depth of 182 m (598 ft) bgs. The 61 cm (24-in.) diameter hole was cased with 0.8 cm (5/16-in.) carbon steel casing and perforated from 149 to 180 m (489 to 592 ft) bgs. A second set of perforations, above the water table and spanning 126 to 138 m (412 to 452) bgs, was added after well development to "provide air outlets". The well had a total of 1.5 m^2 (16 ft^2) of perforations below the water table and 0.5 m^2 (6 ft^2) above the water table (Fromm 1995).

The INTEC injection well was the primary source for liquid waste disposal from 1952 through February 1984 and used intermittently for emergency situations until 1986. The average discharge to the well during this period was approximately 1.4 B L/year (363 M gal/year) or about 3.8 M L/day (1 M gal/day) (DOE-ID 1997b). An estimated total of 22,000 Ci of radioactive contaminants have been released in 4.2×10^{10} L (1.1×10^{10} gal) of water (WINCO 1994). The majority of the radioactivity is attributed to H-3 (approximately 96%). Wastewater may have been injected at several depths depending on the well perforations (Fromm 1995).

The Track 2 Summary Report for CPP-23 Injection Well (1994), Comprehensive RI/FS for OU 3-13 at the INEEL – Part A, RI/BRA Report (DOE-ID 1997) and the OU 3-13 Record of Decision (DOE-ID 1999) identified several contaminants that may have been discharged to the injection well. Based on these reports, the contaminants of potential concern (COPCs) for the injection well include I-129, Sr-90, Pu-isotopes, H-3, Am-241, TC-00, Cs-137, Co-60, Eu-152/-154, arsenic, chromium, mercury, nitrate/nitrite, and osmium. In addition, the injection well has completed RCRA closures as described in the Final Closure Plan for LDU CPP-23 Injection Well (MAH-FE-PL-304) (DOE-ID 1990). In Section 2.1 of this closure plan, it states that "The only known contaminant release to the well identified as a RCRA concern is the mercury release which occurred in March 1981."

As part of the closure effect, a sediment sample was collected from the injection well by the USGS on August 31, 1989 and analyzed for 40 CFR 261 Appendix VIII hazardous constituents, for which EPA-approved methods exist. Analyses of the sediment sample detected traces of metals, radioactivity, and PCBs. No organic compounds, other that PCBs, were detected in the sediment sample form the injection well. The closure plan also required the collections and Appendix VIII analysis of groundwater samples from the adjacent well (USGS-40 and USGS-47) and the production well (Production Well #1). The results also did not detect organic compounds in the groundwater.

Based upon these results, it appears that the COPCs for the injection well consist of radionuclides, metals, and PCBs. For completeness and to address possible uncertainities, the sediments from the injection well will also be sampled for the nine listed waste constituents previously identified at INTEC (benzene, carbon disulfide, carbon tetrachloride, hydrogen fluoride, pyridine, tetrachloroethylene, toluene, 1,1,1-trichloroethane, and trichloroethylene). In addition, the following constituents (acetone, cyclohexane, cyclohexanone, ethyl acetate, methanol, methyl isobutyl, keton, and xylene) were identified to be present in INTEC waste streams (INEEL/EXT-98-01212, revision 1, February 1999) and will be sampled.

Casing disintegration occurred twice (1967 or 1968 and 1981) and was repaired in1971 and 1982. During periods when the injection well was plugged, the waste was discharged directly into the vadose zone resulting in a thick zone of contamination underlying INTEC. This zone may serve as a possible source of contamination to the deep perched water zone and complicates any interpretation of contamination in the subsurface. During repair periods, the waste was injected into USGS-50, a well completed to a depth of 123 m (405 ft) bgs (Fromm 1995).

In October and November 1989, the injection well was sealed by perforating the casing throughout and pumping in cement. The well was sealed from the basalt silt layer (145m [475 ft] bgs) to land surface to prevent hydraulic communication between the land surface, perched water, and SRPA.

Before the well abandonment, a sediment sample was collected from the bottom of the open part of the well (about 145 m [475 ft] bgs). Analysis of the sediment sample detected low concentrations of inorganics, radionuclides, and polychlorinated biphenyls (PCBs). Fourteen inorganics were detected. The concentration of barium (0.26 mg/L) was well below the regulatory threshold of 100 mg/L. The radionculide analyses of the sediments show that the gross beta activity was measured at 150 pCi/g. This analysis also measured Cs-137 at 100 pCi/g, Eu-152 at 3.8 pCi/g, and Eu-154 at 2.5 pCi/g. The only organic compound detected above the method detection limit was Aroclor-1260 at 10 μg/kg (DOE-ID 1997b).

Uncertainty associated with the contaminant source estimates and potential releases from the soil and perched water around the injection well prevented a final remedial action for the SRPA inside the INTEC fence line. This is now part of the OU 3-14 scope, and the final action for the SRPA will be included in the OU3-14 RI/FS, proposed project plan, and ROD.

4.4.2.2 DQO STEP 2—Identify the Decisions. This step of the DQO process lays out the principle study questions, alternative actions, and corresponding decision statements that must be answered to effectively address the above stated problem.

Principal Study Questions—The purpose of the principal study question (PSQ) is to identify key unknown conditions or unresolved issues that, when answered, provide a solution to the problem being investigated, as stated above. The PSQs for this project are as follows:

PSQ-1: Are there any unresolved issues pertaining to the Aquifer quality from the OU 3-13 Group 5 interim action and Group 4 final action? (More information may be obtained by consulting the OU 3-13 ROD [DOE-ID 1999b]).

PSQ-2a: What are the residual contaminants and their concentrations in the sediment inside CPP-3 and in SRPA materials near the well (Site CPP-23)? This analysis includes radionuclides as well as non-radionuclide contaminants.

PSQ-2b: What is the vertical and horizontal extent of the contaminants in the sediment inside the injection well and contaminated sediments near the injection well?

PSQ-2c: If contaminants are present above risk action levels in the sediment and contaminated aquifer materials near the injection well, can they be mobilized and released to the SRPA as a secondary source?

PSQ-3: What are the residual contaminant concentrations in the aquifer near Site CPP-23 of radionuclides and non-radionuclides?

PSQ-4 Do localized hot spots (e.g., iodine-129 at the HI interbed) exceed risk-based action levels in the SRPA?

PSQ-5 Based upon new data obtained during the evaluation of the injection well, sediment in the well, and contaminated aquifer materials near the well, will remedial action be required and what are the best remedial approaches?

Alternative Actions—Alternative actions (AA) are those actions possible resulting from resolution of the above PSQs. The types of actions considered will depend on the answers to the PSQs.

AA-1: A: There are no issues. Proceed. (No consequence is associated with this alternative.)

B: There are issues. Resolve the issues. (Consequences are that additional principal study questions may be added and additional data other than the data listed below may be required. This may have impact on both the schedule and budget.)

AA-2a: A: Analytical results indicate the sediment is free of residual contamination that might pose a risk to the SRPA. Proceed with RI/FS characterization. (No consequence is associated with this alternative.)

B: Analytical results of the soil cores collected from the SRPA indicate that contaminants are present in the material that could potentially be a risk to the SRPA. Characterize the contamination (e.g., waste types, volumes, and secondary source potential). (The consequence is that the contamination will require remediation.)

AA-2b A: Sufficient data exist to determine the contaminant stratification in the sediment and in the contaminated SRPA materials near the injection well to evaluate risk and determine volume concentrations. Proceed with the RI/FS characterization. (No consequence.)

B: Additional data are needed to characterize contaminants in the sediment in the injection well and in the sediments near the injection well. Collect additional data. (The consequence is that additional data will be required to assess risk and determine effective remedial techniques, should they be necessary.)

AA-2c A: Contaminants are strongly sorbed to the sediment and contaminated sediments near the injection well. Proceed with characterization. (No consequence is associated with this alternative.)

B: Contaminants are mobile and are being or potentially can be leached out of the sediment and contaminated SRPA materials. This has implications for possible remedial actions as well as risk considerations. Evaluate the need for Stage II actions. Proceed with characterization. (The final remedial action will be required to minimize contaminant mobility either by removing the contaminants and/or immobilizing them.)

AA-3 A: The radionuclides identified as OU 3-13 COPCs are the only contaminants that are potential threats to the SRPA. Proceed with characterization. (The consequence is that the remedial action will be required to address all known compounds that fulfill OU 3-14 COPC criteria.)

B: Other contamination, in addition to the OU 3-13 COPCs, is present above risk based action levels and could potentially pose a threat to the SRPA. (The consequence is that the remedial action will be required to address all OU 3-14 COPCs.)

AA-4 A: Hot spots do not exist. (The consequence is that additional modeling will be required.)

B: Hot spots exist. Collect more information on hot spots. Rerun the SRPA model. (The consequence requires a remedial action to remove or control the contaminant.)

AA-5 A: Data are adequate to characterize risk and the possible contaminants associated with the former injection well to write an RI/FS, and develop appropriate remedial alternatives, select remedies, and write a ROD. (No consequence is associated with this alternative.)

B: There is still too much uncertainty to write an RI/FS, develop appropriate remedial alternatives, select remedies, and write a ROD. (The consequence is that more data will be required.)

Decision Statements—The decision statements (DS) combine the PSQ and AA into a concise statement of action. The DS for each of the PSQs are stated below.

DS-1: Determine whether there are unresolved issues from the OU 3-13 Groups 4 and 5 final and interim actions (see OU 3-13 ROD [DOE-ID 1999b]).

DS-2a: Determine whether the sampling and analytical results have successfully identified all possible OU 3-14 COPCs in the sediment inside the injection well and SRPA materials near Site CPP-23.

DS-2b: Determine whether the stratification of radionuclide and non-radionuclide contaminants in the sediment inside the injection well are sufficiently characterized to evaluate risk, contaminants, and propose effective remedial actions, if required.

DS-2c: Determine whether contaminants are easily released from the SRPA materials and sediment. If so, remedial actions may be required. High mobility also increases the opportunity for leaching to occur and contaminants becoming a secondary source.

DS-3: Determine whether analytical results and/or risk analysis identifies contaminants in the SPRA water at concentration levels equal to or greater than MCLs.

DS-4 Determine whether hot spots exist in the SRPA with the potential to exceed action levels.

DS-5: The recommended remedial action will be based on the hydraulic, geochemical, and physical drivers, the success of interim actions, and the comparison of identified requirements, associated technology, and their costs.

4.4.2.3 DQO STEP 3—Identify Inputs to the Decision. This step of the DQO process identifies the informational inputs that are required to answer the decision statements made above.

Inputs for PSQ-1—PSQ-1 will be answered through information obtained from WAG-3 OU 3-13 Group 4 and Group 5 investigations. Group 4 will be implementing the OU 3-13 ROD (DOE-ID 1999b) specified remedial actions for the INTEC perched water, while Group 5 will be implementing the ROD-directed interim actions for the SRPA.

- OU 3-13 Group 5 interim action information
- OU 3-13 Group 4 final action information.

Inputs for PSQ-2a—Contaminants of potential concern for the injection well will be identified primarily through the collection and analysis of sediment and water samples collected during drilling activities. Because the well was abandoned and cemented shut in 1989, the cement inside the casing will be drilled out. Continuous core collected from immediately below the cement to a point below the well where injection well effects are no longer visible (this is estimated to be about 15 m (50 ft) below the original bottom of the well) and field screening and visual analysis indicates no contamination is present. Coring will continue 1.5 m (5-ft) below the depth where no contamination was observed. Total input, however, to obtain the OU 3-14 COPCs will be taken from the following list of sources. Throughout the rest of this section, OU 3-14 COPCs refers to the injection well (Site CPP-23) COPCs. Refer to Tables 5-1 and 5-2 of the Injection Well Field Sampling Plan (DOE-ID 2000a) for a complete list of analytes.

The inputs to answer PSQ-2a are the following:

- Core analytical data (radionuclides and non radionuclides)
- USGS downhole geophysical logging
- Historical records
- Process knowledge.

Inputs for PSQ-2b—Vertical extent of contamination in the injection well will be determined by opening the original well by coring (see Inputs for PSQ-2a), and analyzing samples. The OU 3-14 COPCs will be determined from risk and groundwater modeling. To determine the vertical and horizontal extent of the contamination in the sediment near the injection well, a second well will be drilled close to the injection well. Continuous core will be collected of the material below the lower interbed (about 122 m [400 ft] bgs) to the bottom of the well. This well will also be drilled to a point where the injection well effects are no longer apparent (about 198 m [650 ft] bgs). The core will be sampled and analyzed for the analytes of concern (see the Injection Well Field Sampling Plan).

Inputs to answer PSQ-2b are the following:

- Historical records
- Process knowledge
- Analytical data (radionuclides and non radionuclides)
- Risk analysis
- Model predictions

- K_d data
- Hydraulic property data of sediment and SRPA materials.

Inputs for PSQ-2c—To determine whether contaminants in the sediment in and near the injection well can be mobilized, leach and absorption studies will be conducted. Soil used in these extractions will be sampled sediment material collected during the drilling will be used for the leach and absorption studies.

The inputs to answer PSQ-2c are the following:

- Analytical concentration data (radionuclides and non radionuclides)
- Selected soil extractions
- K_d data
- Model predictions
- Hydraulic properties
- Risk analysis.

Inputs for PSQ-3—Residual groundwater concentrations will be primarily determined through sampling the groundwater and the subsequent analytical results. The OU 3-14 COPCs will be determined from the risk and groundwater modeling. Data needed to make a decision for PSQ-3 will come from the sources listed below.

- Historical records
- SRPA analytical data
- Risk analysis results
- Model predictions
- K_d data
- Hydraulic properties
- OU 3-13 Group 5 interim action data
- OU 3-13 Group 4 final action data.

Inputs for PSQ-4—To determine whether the iodine-129 hot spot in the HI interbed exceeds risk based action levels, a third well will be drilled about 91 m (300 ft) down gradient from the injection well. This well will be screened across the HI interbed. Water samples will be collected and analyzed for iodine-129.

The inputs to answer PSQ-4 are the following:

- Historical records

- Core analytical data
- Water analytical data
- Field screening data
- Risk analysis results
- K_d data
- Model predictions
- Hydraulic properties
- OU 3-13 Group 5 interim action data

Inputs for PSQ-5—All data collected to characterize the injection well effects (sediment and SRPA materials) will be used to develop remedial actions, should they be necessary.

The inputs for PSQ-5 are:

- Final OU 3-14 injection well (Site CPP-23) COPC list
- Concentration levels (e.g., in the SRPA, sediment, and SRPA materials)
- Contaminant mobility
- Secondary source information
- OU 3-13 Group 5 interim action data
- OU 3-13 Group 4 final action data
- Hydraulic properties
- K_d data
- Model predictions
- Waste types
- Remedial cost
- Practicability of technology
- Feasibility, maturity, and efficacy of technology.

4.4.2.4 DQO STEP 4—Define the Boundaries of the Study. This study focuses on sufficiently characterizing the injection well (Site CPP-23) to understand the contamination types, levels, distribution, and source term; the risks associated with the contamination; and the hydrology and geochemistry for the purpose of identifying effective remedial actions for the WAG 3 OU3-14 RI/FS, proposed plan, and ROD.

The physical boundaries of the investigation include Site CPP-23 from the ground surface down to and including the SRPA. The SRPA under the entire INTEC is included in the physical boundary of this investigation.

Additional boundaries that could possibly impact the project include:

Schedule boundaries: The schedule may be impacted by the budget allotted for the remedial action. Any loss in the budget without adjustment in scope will extend the schedule. That action may adversely impact the mitigation of the transport of contaminants to the SRPA.

Budget boundaries: The budget is anticipated to remain at a constant funding level during the course of the investigation. This will require that remedial actions be optimized not only technically but also financially.

Concentration boundaries: These boundaries result from contaminant concentrations. For radionuclide concentrations the boundaries extend from low concentrations to the risk-based action levels agreed to in the OU 3-13 ROD. A high dose rate could drive remote remedial methods. Other remedial considerations related to concentration levels include upper inventory levels of possible waste disposal facilities. Metals concentration levels should not impact remedial activities. Should high VOC levels be present, some remedial activities could be affected, e.g., grout and thermal processes.

Operational boundaries: The investigation of the Injection Well could be impacted by ongoing INTEC operations.

Treatment evaluation boundaries: The evaluation of remedial technologies may potentially be impacted by a variety of laboratory-related influences including scale, contamination levels, and heterogeneity. It may also be impacted by the implementability of the treatment.

Integration boundaries: Final remediation may be impacted by the integration of any or all of the above boundaries.

4.4.2.5 DQO STEP 5—Develop a Decision Rule. This step of the DQO process brings together the outputs from steps 1 through 3 into a single statement describing the basis for choosing among the listed alternatives.

- Decision Rule (DR)-1: If there are no unresolved issues from OU 3-13 Group 4 and 5, then proceed with AA-1 A, otherwise proceed with AA-1 B.
- DR-2a: If there is no residual contamination in the sediment or contaminated SRPA materials, then proceed with AA-2a A, otherwise proceed with AA-2a B.
- DR-2b: If there is sufficient data to determine contaminant stratification in the sediment, then proceed with AA-2b A, otherwise proceed with AA-2b B.
- DR-2c: If contaminants are strongly sorbed to the sediment and/or contaminated SRPA materials, then proceed with AA-2c A, otherwise proceed with AA-2c B.

- DR-3: If OU 3-13 COPCs specified in the OU 3-13 ROD are the only contaminants that exceed risk based action levels, then proceed with AA-3 A, otherwise proceed with AA-3 B.

- DR-4: If "hot spots" do not exist, then proceed with AA-4 A, otherwise proceed with AA-4 B.

- DR-5: If sufficient data to characterize the risk and the contaminants associated with the former injection well exist to write a RI/FS, develop appropriate remedial actions and write a ROD, then proceed with AA-5 A, otherwise proceed with AA-5 B.

4.4.2.6 DQO STEP 6—Specify Tolerable Limits on Decision Errors. This step of the DQO process sets out the acceptable limits on decision error. These limits are used to establish performance goals for the data collection design.

Data collected to determine whether contaminants in the SRPA water are at concentration levels equal to or greater than MCLs (DS-3) are amenable to statistically based limits on decision errors. Hypothesis testing will be utilized to determine if an action level (MCL) is exceeded to resolve Principal Study Question 3 (PSQ-3).

The null hypothesis, H_0, is that the true mean of a contaminant is greater than or equal to the MCL. The alternative is that the true mean is less than the MCL.

- H_0: $\mu \geq$ MCL

- H_a: $\mu <$ MCL

The hypothesis testing will be performed to a level of significance, α, of 0.05. In other words, with this level of significance, we limit the probability of a Type I error, or of rejecting the null hypothesis when it is true, to 5%. The hypothesis testing is designed to allow us to control the probability or erroneously concluding that MCLs are not exceeded when in fact they are exceeded. The null hypothesis was formulated based upon the belief that the harmful consequences of incorrectly concluding that a MCL is not exceeded when it actually is exceeded outweigh the consequences of incorrectly concluding that the MCL is exceeded when in fact it is not.

Statistically based decision errors are not appropriate for the other decision statements.

4.4.2.7 DQO STEP 7—Optimize the Design. In addition, the former injection well will be redrilled and the sediment build-up inside the casing cored and sampled. A total of 2 wells will be drilled to the approximate depth of (185.9 m to 198.1 m (610 to 650 ft) below ground surface (bgs). One well will be drilled as close to the former injection well as possible. The wells will be cored to permit the collection of sediments, basalts, and injection well sediment, if it exists outside the original well backhole. The vadose zone cores from the well adjacent to the INTEC injection well will be handled and archived for possible future analysis by OU 3-14. If analytical results indicate contaminant concentrations are not above MCLs or risk based action levels (for any of the contaminants), the RI/BRA will be completed. If concentrations are above MCLs, an RI/FS that includes leachability studies may be performed, in accordance with Section 5.5.2. The final well will be located about 300 ft downgradient from the former injection well. This well is expected to be drilled using an aquifer rotary rig. These wells will be completed as monitoring wells and screened with a 50-ft screen across the HI interbed. Both wells will be sampled quarterly to develop the final OU 3-14 COPC list.

4.4.3 Additional Soil Sites from OU 3-13

Data quality objectives have not been developed for these sites. If the initial evaluation indicates that the sites may require further characterization and eventual remedial actions, then DQOs for these sites will be prepared.

4.5 Model Prediction Accuracy

The accuracy of model predictions is ultimately dependent upon 1) the ability of the code to replicate the modeled system and 2) a good understanding of the system that is being modeled. Remedial designs are often based on simulated future behaviors. If these predictions are to replicate a system, the model-input parameters must reflect a well-understood system. Knowledge of a system is gained through site characterization. When there is uncertainty in assigning values to model parameters, error is introduced leading the model to predict different behaviors than the actual behavior the system exhibits. The degree of error depends on the degree of uncertainty. Uncertainty and the subsequent error can be reduced by collecting actual field data to increase understanding and more accurately define the required model parameters.

As discussed in Section 3.2, the modeling for the OU 3-13 RI resulted in too much uncertainty for remedial decision making. OU 3-14 was created to allow for further characterization of the Tank Farm soil, the INTEC injection well and the SRPA within the INTEC fenceline, and the additional sites from OU 3-13 outside the Tank Farm. The model needs discussed below are the drivers for the development of the specific DQOs and the proposed field investigations.

Table 4-2. OU 3-14 injection well (Site CPP-23) DQOs.

1: State the Problem	2: Identify the Decision			3: Identify Inputs to the Decision	4: Define the Study Boundaries
Background Statement: The former injection well, CPP-3, also known as Site CPP-23 was the primary source for liquid waste disposal from 1952 through February 1984 and used intermittently for emergency situations until 1986. The average discharge to the well during this period was approximately 1.4 B L/yr (363 M gal/year) or about 3.8 M L/day (1 M gal/day) (DOE-ID 1997b). It has been estimated that a total of 22,000 Ci of radioactive contaminants have been released in 4.2×10^{10} L (1.1×10^{10} gal) of water (WINCO 1994). The majority of the radioactivity is attributed to H-3 (approximately 96% of the total curies). The Track 2 Summary Report for CPP-23 Injection Well (1994), Comprehensive RI/FS for OU 3-13 at the INEEL – Part A, RI/BRA Report (DOE-ID 1997) and the OU 3-13 Record of Decision (DOE-ID 1999) identified several contaminants that may have been discharged to the injection well. Based on these reports, the contaminants of potential concern (COPCs) for the injection well include I-129, Sr-90, Pu-isotopes, H-3, Am-241, TC-00, Cs-137, Co-60, Eu-152/-154, arsenic, chromium, mercury, nitrate/nitrite, and osmium. In addition, the injection well has completed RCRA closures as described in the Final Closure Plan for LDU CPP-23 Injection Well (MAH-FE-PL-304) (DOE-ID 1990). In Section 2.1 of this closure plan, it states that "The only known contaminant release to the well identified as a RCRA concern is the mercury release which occurred in March 1981." As part of the closure effect, a sediment sample was collected from the injection well by the USGS on August 31, 1989 and analyzed for 40 CFR 261 Appendix VIII hazardous constituents, for which EPA-approved methods exist. Analyses of the sediment sample detected traces of metals, radioactivity, and PCBs. No organic compounds, other that PCBs, were detected in the sediment sample form the injection well. The closure plan also required the collections and Appendix VIII analysis of groundwater samples from the adjacent well (USGS-40 and USGS-47) and the production well (Production Well #1). The results also did not detect organic compounds in the groundwater. Based upon these results, it appears that the COPCs for the injection well consist of radionuclides, metals, and PCBs. For completeness and to address possible uncertainities, the sediments from the injection well will also be sampled for the nine listed waste constituents previously identified at INTEC (benzene, carbon disulfide, carbon tetrachloride, hydrogen fluoride, pyridine, tetrachloroethylene, toluene, 1,1,1-trichloroethane, and trichloroethylene). In addition, the following constituents (acetone, cyclohexane, cyclohexanone, ethyl acetate, methanol, methyl isobutyl, keton, and xylene) were identified to present in INEEL waste streams (INEEL/EXT-98-01212, revision 1, February 1999) and will be sampled. The well was initially drilled in 1950 to a depth of 65 m (212 ft) bgs and abandoned. In 1952 the borehole was cleaned out and deepened to a depth of 182 m (598 ft) bgs. The 61 cm (24-in.) diameter hole was cased with 0.8 cm (5/16-in.) carbon steel casing and perforated from 149 to 180 m (489 to 592 ft) bgs. A second set of perforations, above the water table and spanning 126 to 138 m (412 to 452) bgs, was added after well development to "provide air outlets". The well had a total of 1.5 m^2 (16 ft^2) of perforations below the water table and 0.5 m^2 (6 ft^2) above the water table. The "injection effect" of CPP-3 created high ground water velocities immediately around the release point, as much as 1,524 m (5,000 ft) per day. This effect became insignificant at distances greater than 305 m (1,000 ft) from the disposal well. Water initially moved radially out around the well for some distance, overriding the regional flow direction. Wastewater may have been injected at several depths depending on the well perforations. There are two intervals of casing disintegration (1967 or 1968 and 1981) and repair (1971 and 1982). During periods when the injection well was plugged, the waste were discharged directly into the vadose zone resulting in a thick zone of contamination underlying INTEC. This zone may serve as a possible source of contamination to the deep perched water zone and complicates any interpretation of contamination in the subsurface. During repair periods, the waste were also injected into USGS-50, a well completed at 123 m (405 ft) bgs. In October and November 1989, the injection well was sealed by perforating the casing throughout and pumping in cement. The well was sealed from the basalt silt layer (145m [475 ft] bgs) to land surface to prevent hydraulic communication between the land surface, perched water, and SRPA. Before the well abandonment, a sediment sample was collected from the bottom of the open part of the well (about 145 m [475 ft] bgs). Analysis of the sediment sample detected low concentrations of inorganics, radionuclides, and polychlorinated biphenyls (PCBs). Fourteen inorganics were detected. The concentration of barium (0.26 mg/L) was well below the regulatory threshold of 100 mg/L. The radionculide analyses of the sediments show that the gross beta activity was measured at 150 pCi/g. This analysis also measured Cs-137 at 100 pCi/g, Eu-152 at 3.8 pCi/g, and Eu-154 at 2.5 pCi/g. The only organic compound detected above the method detection limit was Aroclor-1260 at 10 μg/kg (DOE-ID 1997a). Due to the uncertainty associated with the contaminant source estimates and potential releases from the soil and perched water around the injection well, the final remedial action for the SRPA inside the INTEC fence line is part of the OU 3-14 scope and will be included in the OU3-14 RI/FS, project plan, and ROD. **Problem Statement**: The potential problem involving the SRPA is two-fold. First, the injection well is known to have injected contaminated fluids into the SRPA. A 36.6-m (120-ft) sediment column has built-up inside the casing. The volume of residual contamination is not well characterized, nor are the specific contaminants, their amounts, concentrations, and mobility. Second, there is uncertainty resulting from contaminant source estimates and potential releases from the vadose zone in the vicinity of the injection well.	Success at meeting the remedial action objective will be determined by obtaining sufficient characterization data to develop a RI/FS, proposed plan, and ROD from which a remedial action can be implemented that will prevent contaminants associated with the injection well (CPP-3) from adversely impacting the SRPA under INTEC.				This study focuses on sufficiently characterizing the injection well (Site CPP-23) to understand the contamination types, levels, distribution, and source term; the risks associated with the contamination; and the hydrology and geochemistry for the purpose of identifying effective remedial actions for the WAG 3 OU3-14 RI/FS, proposed plan, and ROD. The physical boundaries of the investigation include Site CPP-23 from the ground surface down to and including the SRPA. The SRPA under the entire INTEC is included in the physical boundary of this investigation. Additional boundaries that could possibly impact the project include: *Schedule boundaries*: The schedule may be impacted by the budget allotted for the remedial action. Any loss in the budget without adjustment in scope will extend the schedule. That action may adversely impact the mitigation of the transport of contaminants to the SRPA. *Budget boundaries:* The budget is anticipated to remain at a constant funding level during the course of the investigation. This will require that remedial actions be optimized not only technically but also financially. *Concentration boundaries:* These boundaries result from contaminant concentrations. For radionuclide concentrations the boundaries extend from low concentrations to the risk-based action levels agreed to in the OU 3-13 ROD. A high dose rate could drive remote remedial methods. Other remedial considerations related to concentration levels include upper inventory levels of possible waste disposal facilities. Metals concentration levels should not impact remedial activities. Should high VOC levels be present, some remedial activities could be affected, e.g., grout and thermal processes. *Operational boundaries:* The investigation of the Injection Well could be impacted by ongoing INTEC operations. *Treatment evaluation boundaries:* The evaluation of remedial technologies may potentially be impacted by a variety of laboratory-related influences including scale, contamination levels, and heterogeneity. It may also be impacted by the implementability of the treatment. *Integration boundaries:* Final remediation may be impacted by the integration of any or all of the above boundaries.
	Principal Study Questions	Alternative Actions	Decision Statement		
	PSQ-1: Are there any unresolved issues pertaining to the Aquifer quality from the OU 3-13 Group 5 interim action and Group 4 final action? (More information may be obtained by consulting the OU 3-13 ROD [DOE-ID 1999b]).	A: There are no issues. Proceed. (No consequence.) B: There are issues. Resolve the issues. (Consequences are that additional principal study questions may be added and additional data other than what is listed below may be required. This may have impact on both the schedule and budget.)	DS-1: Determine whether there are unresolved issues from the OU 3-13 Groups 4 and 5 final and interim actions.	Inputs to the PSQ-1 decision include: OU 3-13 Group 5 interim action information OU 3-13 Group 4 final action information	
	PSQ-2a: What are the residual contaminants and their concentrations in the sediment inside CPP-3 and in SRPA materials near the well (Site CPP-23)? This analysis includes radionuclides as well as non-radionuclide contaminants.	A: Analytical results indicate the sediment is free of residual contamination that might pose a risk to the SRPA. Proceed with RI/FS characterization. (No consequence is associated with this alternative.) B: Analytical results of the sample cores collected from the wells indicate that there are contaminants present in the material that could potentially be a risk to the SRPA. Determine waste types, volumes, secondary source potential, etc. (The consequence is that the contamination will require remediation.)	DS-2a: Determine whether the sampling and analytical results have successfully identified all contaminants in the sediment in and near CPP-3.	Inputs to the PSQ-2a decision include: Core analytical data (rad and non rad) USGS downhole geophysical logging Historical records Process knowledge and risk analysis	
	PSQ-2b What is the vertical and horizontal extent of the contaminants in the sediment inside the injection well and contaminated aquifer materials near the injection well?	A: Sufficient data exist to determine the contaminant stratification in the sediment and in the contaminated SRPA materials near the injection well to evaluate risk and determine volume concentrations. Proceed with the RI/FS characterization. (No consequence is associated with this alternative.) B: Additional data are needed to characterize contaminants in the sediment in the injection well and in the sediments near the injection well. Collect additional data. (The consequence is that additional data will be required to assess risk and determine effective remedial techniques, should they be necessary.)	DS-2b: Determine whether radionuclide and non-radionuclide contaminants in the sediment inside the injection well and in SRPA materials near the injection are sufficiently characterized to evaluate risk, contaminants, and propose effective remedial actions, if required.	Inputs to the PSQ-2b decision include: Historical records Process knowledge Analytical data (rad and non rad) Risk analysis Model predictions K_d data Hydraulic property data	
	PSQ-2c: If contaminants are present above risk action levels in the sediment and contaminated aquifer materials near the injection well, can they be mobilized and released to the SRPA as a secondary source?	A: Contaminants are strongly sorbed to the sediment and contaminated sediments near the Injection well. Proceed with characterization. (No consequence is associated with this alternative.) B: Contaminants are mobile and are being or potentially can be leached out of the sediment and contaminated SRPA materials. This has implications for possible remedial actions as well as risk considerations. Evaluate need for Stage II actions. Proceed with characterization. (The final remedial action will be required to minimize contaminant mobility either by removing the contaminants and/or immobilizing them.)	DS-2c: Determine whether contaminants are easily released from the soil and sediment. If so, remedial actions such as sediment and contaminated sediments removal, for example, may be required. High mobility also increases the opportunity for leaching to occur and contaminants becoming a secondary source.	Inputs to the PSQ-2c decision include: Analytical concentration data (rad and non rad) Selected soil extractions K_d data Model predictions Hydraulic properties Risk analysis	
	PSQ-3: What are the residual contaminant concentrations in the Aquifer near Site CPP-23 of radionuclides and non-radionuclides?	A: The radionuclides identified as OU 3-13 COPCs are the only contaminants that are potential threats to the SRPA. Proceed with characterization. (The consequence is that the remedial action will be required to address all known compounds that fulfill OU 3-14 COPC criteria.) B: Other contaminants, in addition to the OU 3-13 COPCs, are present above risk based action levels and could potentially pose a threat to the SRPA. (The consequence is that the remedial action will be required to address all OU 3-14 COPCs.)	DS-3: Determine whether analytical results and/or risk analysis identifies contaminants in the SPRA water at concentration levels equal to or greater than MCLs.	Inputs to the PSQ-3 decision include Historical records SRPA analytical data Risk analysis results Model predictions K_d data Hydraulic properties OU 3-13 Group 5 interim action data OU 3-13 Group 4 final action data	
	PSQ-4: Do localized hot spots (e.g., iodine-129 at the HI interbed) exceed risk-based action levels in the SRPA?	A.: Hot spots do not exist. (The consequence is that additional modeling will be required.). B: Hot spots exist, e.g., I-129 is found in the HI interbed at levels that exceed risk based action levels. Collect more information on hot spots. Rerun the SRPA model. (The consequence requires a remedial action to remove or control the contaminant.)	DS-4: Determine whether hot spots exist in the SRPA with the potential to exceed action levels.	Inputs to the PSQ-4 include Historical records Core analytical data Pore water analytical data Field screening data Risk analysis results K_d data Model predictions Hydraulic properties OU 3-13 Group 5 interim action data	

Table 4-2. (continued).

	PSQ-5 Based upon new data obtained during the evaluation of the injection well, sediment in the well, and contaminated aquifer materials near the well, will remedial action be required and what are the best remedial approaches?	A: There is enough data to characterize risk and the possible contaminants associated with the former injection well and Tank Farm soil to write a RI/FS, ROD, and develop appropriate remedial alternatives. (No consequence.)	DS-5: The recommended remedial action will be based on the hydraulic, geochemical, and physical drivers; the success of the interim actions; and the comparison of identified requirements, associated technology, and their costs.	Inputs to the PSQ-5 decision include: Final OU 3-14 injection well (Site CPP-23) COPC list Concentration levels (SRPA, sediment, and SRPA materials) Contaminant mobility Secondary source information OU 3-13 Group 4 and 5 data Hydraulic properties K_d data Model predictions Waste types Remedial cost Practicability, feasibility, and maturity technology	
		B: There is still too much uncertainty to develop an RI/FS, ROD, or suggest appropriate remedial actions. (The consequence is that more data will be required.)			

Table 4-2. (continued).

5: Develop a Decision Rule	6: Specify Tolerable Limits on Decision Errors	7: Optimize the Design
DS-1: If there are no unresolved issues from OU 3-13 Group 4 and 5, then proceed with Alternative A, otherwise proceed with Alternative B.	Data collected to determine whether contaminants in the SRPA water are at concentration levels equal to or greater than MCLs (DS-3) are amenable to statistically based limits on decision errors. Hypothesis testing will be utilized to determine if an action level (MCL) is exceeded to resolve Principal Study Question 3 (PSQ-3).	A total of 3 wells will be drilled to the approximate depth of 198 m (650 ft) below ground surface (bgs). One of the wells will be placed directly inside the former injection well. A second well will be drilled as close to the former injection well as possible. Both of these wells will be cored to permit the collection of sediments, basalts, and injection well sediment. The vadose zone cores from the well adjacent to the INTEC injection well will be handled and archived for possible future analysis by OU 3-14. Samples will be analyzed for the analytes of concern identified in the injection well field sampling plan. If analytical results indicate contaminant concentrations are not above MCLs or risk based action levels (for any of the contaminants), the RI/BRA will be completed. If concentrations are above MCLs, an RI/FS that includes leachability studies may be performed. The second well will be completed as a monitoring well.
DS-2a: If there are no residual contamination in the sediment or contaminated SRPA materials, then proceed with Alternative A, otherwise proceed with Alternative B.	The null hypothesis, H_0, is that the true mean of a contaminant is greater than or equal to the MCL. The alternative is that the true mean is less than the MCL.	The third well will be located about 91.4 m (300 ft) down gradient from the former injection well. This well will also be cored and samples collected for possible future analyses. This well will be completed as a monitoring well and screened with a 15.2 m (50-ft) screen across the HI interbed.
DS-2b: If there is sufficient data to determine contaminant stratification in the sediment, then proceed with Alternative A, otherwise proceed with Alternative B.	H_0: $\mu \geq$ MCL0 H_a: $\mu <$ MCL	The two monitoring wells will be sampled quarterly for to develop the final OU 3-14 COPC list.
DS-2c: If contaminants are strongly sorbed to the sediment and/or contaminated SRPA materials, then proceed with Alternative A, otherwise proceed with Alternative B.	The hypothesis testing will be performed to a level of significance, α, of 0.05. In other words, with this level of significance, we limit the probability of a Type I error, or of rejecting the null hypothesis when it is true, to 5%. The hypothesis testing is designed to allow us to control the probability or erroneously concluding that MCLs are not exceeded when in fact they are exceeded. The null hypothesis was formulated based upon the belief that the harmful consequences of incorrectly concluding that a MCL is not exceeded when it actually is exceeded outweigh the consequences of incorrectly concluding that the MCL is exceeded when in fact it is not.	
DS-3: If OU 3-13 COPCs specified in the OU 3-13 RODs are the only contaminants that exceed risk based action levels, then proceed with Alternative A, otherwise proceed with Alternative B.		
DS-4: If "hot spots" do not exist, then proceed with Alternative A, otherwise proceed with Alternative B.	Statistically based decision errors are not appropriate for the other decision statements.	
DS-5: If sufficient data to characterize the risk and the contaminants associated with the former injection well to write a RI/FS, ROD, and develop appropriate remedial actions exist, then proceed with Alternative A, otherwise proceed with Alternative B	Add new information under 4.4.2.8.	

In the following sections, model uncertainty and data requirements for each model will be discussed. The model needs presented in the following subsections resulted from the WAG 3 OU 3-13 RI/BRA modeling and outlined in the RI/BRA report (DOE-ID 1997a). They have also been presented (in greater detail) in section 3.2 of this document.

4.5.1 OU 3-13 Model Uncertainty Summary

An assessment of the uncertainty associated with the OU3-13 RI/BRA modeling was detailed in the RI/BRA Report (DOE-ID 1997a).

The following is a brief discussion of OU 3-13 model components that introduced uncertainty into the OU 3-13 RI/BRA modeling.

- **Conceptual Model**––Conceptual model uncertainty involves the ability of the vadose zone and aquifer conceptual models to represent hydraulic conditions and contaminants transport. The OU 3-13 RI/BRA modeling indicated that there were insufficient field measurements available to calibrate Sr-90 transport through the Tank Farm soil, as a result of dispersive flux. Therefore, it was not possible to calculate the uncertainty associated with the Sr-90 predicted aquifer concentrations from discharges at the Tank Farm.

- **K_d Values**—The OU 3-13 RI/BRA modeling was particularity sensitive to the K_d values for Sr-90 and Plutonium, meaning that small changes in this parameter resulted in widely differing results. The uncertainty associated with this parameter alone had the potential to introduce large error into the predicted behavior. Further, K_d values for most of the OU 3-13 COPCs modeled were not based on INEEL field calibrated modeling, but rather were taken from literature or other sources.

- **Contaminant Source**—The levels of uncertainty associated with the source term used for modeling depends on the specific source. Two of the primary source components are a) the chemical composition of the spill site, and b) the temporal discharge history of a given contaminant. Further, the injection well releases, Tank Farm releases, and contaminated soil were determined to be the most significant contributors to the total INTEC OU 3-13 COPC inventory.

- ***Tank Farm Soil***—Contaminants have generally been released to the Tank Farm soil by spills and leaks. Knowledge of the spill volumes and contaminants has been developed from process knowledge. This information is believed to be fairly accurate. However, the same information is needed for leaks. Characterization of the leaks has been more difficult with more uncertainty. The following is a summary of the uncertainty associated with the source term at the Tank Farm. Locations for the following sites are shown on Figure 3-1.

  - **CPP-26:** Contamination at this site resulted from a 1964 spill. There is a high level of uncertainty in the estimated source volume, but the total activity is likely to be small relative to the total activity in the Tank Farm soil. The uncertainty should have minimal impact on assessing groundwater pathway.

  - **CPP-31:** This spill was discovered in 1975 and represents about 50% of the known source term for the Tank Farm soil. Because this is such a significant source, additional confirmation sampling would reduce the level of uncertainty associated with the source. Concentrations of specific isotopes are not well defined. Release characteristics are unknown. Depth-profile sampling is needed to evaluate the depth of penetration of the spill.

- **CPP-32:** This spill represents two areas of soil contamination near a valve box. Limited field investigations of the two spills were performed. It is known that OU 3-13 COPCs at this site include Cs-137, Eu-154, and Sr-90. Recent characterization of this site has been prevented by uncertainty associated with spill location.

- **CPP-58E:** This is a spill that is composed of two areas of soil contamination associated with the PEW Evaporator. Little known about extent of contamination, but the volume of the release and the activity involved are known.

- **CPP-79:** Approximately 9.5 m^3 (2,500 gallons) of waste containing radionuclides, heavy metals, and tracer of organic compounds was spilled in 1986 near the WCF Sump Tank (WCF-119). The release estimated at 42 Ci. This release overlies a much greater zone of contamination at depth. The deeper zone of contamination is believed to result from a CPP-28 release.

- **CPP-15:** The 1974 leak resulted from solvent burner operations. The quantity of spilled liquid is unknown. Subsequent soil analysis indicated the presence of suite of radionuclides. However, the characterization of the site is incomplete and inadequate.

- **CPP-27 and CPP-33:** These sites consist of soil contaminated by a subsurface leak of high-level waste from the Tank Farm transfer system near the northeast corner of building CPP-604. Nature and extent of contamination east of CPP-27 is not well defined.

- **CPP-28**: This is the contaminated soil associated with a subsurface leak discovered in 1974 of high-level liquid waste from a breached transfer line. This is a major known release; lateral extent not well defined; volume of release roughly estimated and uncertain; high radionuclide concentrations (first cycle raffinate); small uncertainties in release volume translate into large model uncertainties. The release may have migrated to basalt and may not be possible to determine the extent of the release and source concentrations; sampling needed to provide vertical profile.

- **CPP-58W**: CPP-58W is composed of two areas of contamination associated with the PEW Evaporator. The CPP-58W site is affected by a 1954 leak from a transfer pipe. There is no information on how often the transfer line was used, how long the pipe leaked, or the quantity of condensate released.

- **CPP-96:** Further definition of areas where contaminated soil was used as backfill for Tank Farm activities, and levels of contamination in the material are needed for risk assessment and source evaluation.

- **CPP-20**: Site CPP-20 is a location north of building CPP-604. Small spills of radioactive liquid waste occurred as waste was being unloaded. It has been reported that the spills were cleaned up as they occurred, but no records exist documenting the types, quantities, and locations of the spills.

- **CPP-25:** CPP-25 is located in the same general area as CPP-20. It is the location of a ruptured transfer line that was being used to transfer liquid waste. An unknown quantity of radioactive liquid was released.

- **INTEC Injection Well and Aquifer within the INTEC Fence Line**—The source term for the injection well resulting from residual contamination that may be present in the 37-m (120-ft) column of sediment inside the well, residual contamination in SRPA materials, and contamination that may be present in the groundwater as result of slow-moving plumes of contaminants is uncharacterized. Much is known about the discharge history for some of the OU 3-13 COPCs (H-3, Sr-90, and Cs-137) but not for the OU 3-13 COPCs Am-241, Np-237, and Tc-99. As a result, the uncertainty for those contaminants is higher, and virtually impossible to quantify without more temporal data.

- **Additional Soil Sites From OU 3-13**—There is uncertainty that a source term exists in these sites. If it does, it has not been characterized.

- **Contaminant Specific Uncertainty**—Each OU 3-13 COPC is subject to different levels of uncertainty. In addition, the relative importance of quantifying the uncertainty associated with each OU 3-13 COPC varies depending on the ultimate prediction of risk.

- **Moisture Content**—This is a parameter for the vadose zone model. The RI/BRA modeling used values that were developed at another INEEL site with dissimilar geology. Site-specific measurements are needed to quantify the flux through the Tank Farm soil.

4.5.2 Tank Farm Soil—Tank Farm Soil Model Needs and DQOs

Model needs associated with the Tank Farm and corresponding to the Tank Farm DQOs are discussed in the following subsections.

DQO questions PSQ-1a, -1b, -2a, and -2b (Section 4.4) are designed to address the uncertainties discussed above. Questions 1a and 1b are designed to locate both known and unknown (if they exist) sources in the Tank Farm soil. These questions will be answered by performing the gamma survey and limited soil sampling. The gamma survey probe holes, will initially be placed at 50-ft centers with additional probe holes placed in known significant spill areas (e.g., Sites CPP-28/79 and CPP-31) and in areas (e.g., valve piping) where the potential exists that spills and leaks may have occurred.

Question PQS-2a and 2b are designed to determine activities and concentrations of the analytes of concern (see Tank Farm Field Sampling Plan) from which a OU 3-14 Tank Farm soil COPC list will be developed. Answering this question will require information from the gamma survey and soil and soil pore water sampling and analyses.

Accurately answering these questions will greatly reduce the uncertainty associated with the source term model predictions and lead to the selection of appropriate remedial actions.

Tank Farm Soil Model. As explained earlier, the Tank Farm soil model will incorporate the source term model. The vertical boundaries on the Tank Farm Soil model will extend from the Tank Farm surface down to the sediment/basalt interface (about 14 m [45 ft]). The Tank Farm soil fate and transport model requires input from selected parameters. The parameters can be adjusted to calibrate the model, causing it to match the observed system. The parameters with the greatest degree of uncertainty other than selecting the appropriate conceptual model include quantifying the source term and the flux through the system.

Flux through the Tank Farm soil is a combination of several inputs. These include volume of recharge, recharge sources, moisture content, and hydraulic gradient. The DQO questions that correspond to these needs are PSQ-4a and 4b. The questions will be answered by monitoring moisture and matric potential at the sampling stations to be installed in and near the Tank Farm during Phase II.

DQO question PSQ-3 requires information about contaminant mobility. During the gamma survey samples of Tank Farm soil will be collected. Some of the material will be used in leach and absorption studies. Specific contaminants to be tested in the extraction studies will be determined after PSQ-2a and –2b are answered. Additional sample material will be used to determine site-specific geochemistry that will include but not necessarily be limited to: pH, redox potential, K_ds, and carbon dioxide.

Uncertainty in the Tank Farm soil model will be further reduced by collecting information that will serve as inputs to DQO questions PSQ-2a, -2b, -3, -4a, -4b, and -5. Additional sample material will be used to determine inputs to the DQOs. These include hydraulic property data, to include field scale moisture characteristic curves. Table 4-3 summarizes the Tank Farm soil model needs correlated with various steps in the DQO process.

4.5.3 INTEC Injection Well and Aquifer Within the INTEC Fence Line—Model Needs and DQOs

Some of the contaminants in the process wastewater pumped down the injection well are fairly well characterized. Others are not increasing the uncertainty associated with the model predictions. Uncertainty also arises with the residual contamination. Contaminants and concentrations that may have sorbed to aquifer materials or otherwise remain in the injection well area are unknown. One hundred-twenty feet of sediment is estimated to have collected inside the injection well casing. Contaminants and concentrations in the sediment are not characterized. Also, contaminant concentrations in the Aquifer near the injection well are not characterized. The potential release rate for the contaminants from the sediment or contaminated aquifer materials is not understood.

Injection well DQO questions PSQ-2a, -2b, and –3 have been designed to assess source term issues. The remedial design (DQO Step 7) provides for drilling two SRPA wells and coring out the INTEC injection well. The SRPA wells will be drilled to the same depth as the injection well. The injection well core will be sampled and analyzed for the analytes of concern identified in the injection well field sampling plan to determine the OU 3-14 COPCs. The former INTEC injection well will be cored from the cement to the bottom of the well. Both the injection well and the SRPA well near the injection well will be cored to a depth below the former injection wells' depth to a point where effects from the injected wastewater is not visible or detectable with a field screen.

If significant residual contaminant concentrations are found in and around the injection well, the mobility of the contaminants will be needed for the source term model. Contaminant mobility will be assessed by performing leach and absorption studies on the cored material. The results from these studies will provide an answer to the DQO question PSQ-2c.

The OU 3-13 model predicted that an I-129 hot spot existed in the HI interbed (580 to 600 ft.) down gradient from the injection well. The remedial design calls for drilling the third well in the hot spot area and screening the well across the HI interbed. Water samples will be collected and analyzed to verify I-129 concentrations and model predictions. The model will be used to determine whether I-129 concentrations detected in the HI interbed can become secondary contamination sources to the SRPA. If they can, the I-129 information will need to be incorporated into the SRPA source term model. This information will be used to answer DQO question PSQ-4.

Table 4-4 summarizes the injection well model needs correlated with various steps in the DQO process.

Table 4-3. Tank Farm soil models needs and data gaps.

DQO Principal Study Question (DQO Step 2)	Model Needs	Inputs (DQO Step 3)	How Characterization will meet Model Requirement (from DQO Step 7)	Characterization will Provide
PSQ-1a: What is the number and spacial extent of the high contamination zones in the 0 to 3m (0 to 10 ft) depth range? (This is required for evaluation of the external risk and possible remedial alternatives.)	Qualification of Source Term	• Historical record • Process knowledge • Gamma survey data • Neutron survey data • Nuclear constants • Ratio estimation • Soil analytical results • Pore-water analytical result • K_d data	Gamma screen at 15.2 m (50-ft) centers • Will provide nature and extent information on known releases and screen for potential unknown releases Additional sampling at known release sites and at potential release sites • Help define nature and extent for Tank Farm releases Soil sampling and analysis • Quantify source terms • Identify potential metal and VOC contaminants Soil-pore water sampling and analysis • Quantify radionuclide source terms • Identify potential metal and VOC contaminants • Information on contaminant transport	Reduce uncertainty related to release size, location, migration, activity, dose rate, concentration, and contaminants.
PSQ-1b: What is the number and spatial extent of the high contamination zones in the 0 to 13.7 m (0 to 45-ft) depth range? (This is required for possible remedial alternatives.)	Qualification of Source Term	• Historical records • Process knowledge • Gamma survey data • Neutron survey data • Nuclear constants • Ratio estimation • Soil analytical results • Pore-water analytical result • K_d datas	Gamma screen at 15.2 m (50-ft) centers in Tank Farm soil • Will provide nature and extent information on known releases and screen for potential unknown releases Additional sampling at known release sites and at potential release sites • Help define nature and extent for Tank Farm releases Soil sampling and analysis • Quantify source terms • Identify potential metal and VOC contaminants Soil-pore water sampling and analysis • Quantify radionuclide source terms • Identify potential metal and VOC contaminants • Information on contaminant transport	Reduce uncertainty related to release size, location, migration, activity, dose rate, concentration, and contaminants.

Table 4-3. (continued).

DQO Principal Study Question (DQO Step 2)	Model Needs	Inputs (DQO Step 3)	How Characterization will meet Model Requirement (from DQO Step 7)	Characterization will Provide
PSQ-2a: What are the radionuclide contaminants in each of the high contamination zones (from 0 to 13.7 m [0 to 45 ft bgs])?	Identification of Source Term	• Historical records • Soil analytical data • Soil-pore water analytical data • Field screening data • Risk analysis results • Model predictions • Hydraulic properties • K_d data	Gamma screen at 50-ft centers in Tank Farm soil • Will provide contaminant type information on known releases and potential unknown releases Additional sampling at known release sites and at potential release sites • Help identify contaminant types for Tank Farm releases Soil sampling and analysis • Identify radionuclide contaminants • Soil-pore water sampling and analysis • Identify radionuclide contaminants • Information on contaminant transport	Reduce uncertainty related to radionuclide contaminants.
PSQ-2b: Are there non-radionuclide contaminants present in the Tank Farm soil from 0 to 13.7 m (0 to 45 ft bgs) (in addition to those currently identified)?	Identification of Source Term	• Historical records • Process knowledge • Soil analytical data • Soil-pore water analytical data • Field screening data • Risk analysis results • Model predictions • Hydraulic properties • K_d data	Additional sampling at known release sites and at potential release sites • Help identify contaminant types for Tank Farm releases Soil sampling and analysis • Identify potential metal and VOC contaminants Soil-pore water sampling and analysis • Identify potential metal and VOC contaminants Information on contaminant transport	Reduce uncertainty related to non-radionuclide contaminants.
PSQ-3: Are any of the contaminants mobile so that they can be leached from the soil?	Vadose zone OU 3-14 COPC mobility	• Analytical concentration data • Selected soil extractions (leach and absorption studies) • K_d data • Site-specific geochemistry • Model predictions • Hydraulic properties	Additional sampling at known release sites and at potential release sites • Help identify contaminant types for Tank Farm releases Soil-pore water sampling and analysis • Identify OU 3-14 COPCs Tank Farm soil sampling • Sample material for leach and absorption studies • Sample material for site-specific geochemistry studies • Hydraulic property analysis	Reduce errors in model calibration and contaminant transport.
PSQ-4a: Is there a vertical moisture flux moving from the Tank Farm soil into the basalt?	Tank Farm vertical flux	• Moisture data • Matric potential data • Contaminant concentrations • Model predictions • Hydraulic property data • Recharge sources • K_d data	Tank Farm soil sampling • Hydraulic property analysis • Site-specific geochemistry Moisture monitoring • Vertical moisture and hydraulic gradient profiles • Recharge sources	Reduce uncertainty associated with infiltration and deep drainage and consequent contaminant transport

Table 4-3. (continued).

DQO Principal Study Question (DQO Step 2)	Model Needs	Inputs (DQO Step 3)	How Characterization will meet Model Requirement (from DQO Step 7)	Characterization will Provide
PSQ-4b: Is there a horizontal moisture flux into the Tank Farm soil?	Tank Farm horizontal flux	• Moisture data • Matric potential data • Contaminant concentration data • Model predictions • Hydraulic property data • Recharge source • K_d data	Tank Farm soil sampling • Hydraulic property analysis • Site-specific geochemistry Moisture monitoring • Horizontal moisture and hydraulic gradient profiles • Recharge sources	Reduce uncertainty associated with infiltration and deep drainage and consequent contaminant transport
PSQ-5 Based on new data obtained during evaluation of the Tank Farm high contamination zones and soil moisture, what are the best final remedial approaches	Risk to the SRPA	• Compile the final OU 3-14 Tank Farm soil COPC list • Concentration levels • Contaminant flux • Number of high contamination zones • Waste volume • Tank heels • Recharge water/sources • Site-specific geochemistry data • Deep drainage • Hydraulic properties • Model predictions • Waste types (TRU, RCRA, characteristic, TSCA, mixed, etc.) • Remedial cost • Impracticability of technology • Technical feasibility of remediation technology • Maturity of technology • Efficacy of technology Source term for soil Source term for soil and closed tanks	Gamma screen at 50-ft centers • Will provide nature and extent information on known releases and screen for potential unknown releases Additional sampling at known release sites and at potential release sites • Help define nature and extent for Tank Farm releases Soil sampling and analysis • Quantify source terms • Identify potential metal and VOC contaminants Soil-pore water sampling and analysis • Quantify radionuclide source terms • Identify potential metal and VOC contaminants • Information on contaminant transport Tank Farm soil sampling • Hydraulic property analysis • Site-specific geochemistry Moisture monitoring • Vertical and horizontal moisture and hydraulic gradient profiles • Recharge sources	Reduce uncertainty associated with selected remedial alternatives and potential risk to receptors in the SRPA.

Table 4-4. Injection well model needs and data gaps.

DQO Principal Study Question (DQO Step 2)	Model Needs	Inputs (DQO Step 3)	How Characterization will meet Model Requirement (from DQO Step 7)	Characterization will Provide
PSQ-2a: What are the residual contaminants and their concentrations in the basalt and sediments near Site CPP-23 and in the sediment inside and near the well? This includes radionuclides as well as non-radionuclide contaminants	Qualification of Source Term	• Core analytical data (rad and non rad) • USGS downhole geophysical logging • Historical records • Process knowledge	Drill out the injection well; core sediment in of well; core material beneath the well to depth where injection well affects not detectable • Sample core, analyze for analytes of concern Drill well near injection well. • core beneath 122 m (400 –ft) interbed. • Sample core and analyze for analytes of concern Perform gamma survey	Reduce uncertainty related to release size, location, migration, activity, dose rate, concentration, and contaminants.
PSQ-2b What is the vertical and horizontal extent of the contaminants in the sediment inside the injection well and contaminated sediments near the injection well?	Qualification of Source Term	• Historical records • Process knowledge • Analytical data (rad and non rad) • Risk analysis • Model predictions • K_d data • Hydraulic property data	Drill out the injection well; core sediment in well; core material beneath well to depth where injection well affects are not detectable. • Sample core, analyze for analytes of concern Drill well near injection well. • Core beneath 122 m (400 –ft) interbed. • Sample core and analyze for analytes of concern Perform gamma survey	Reduce uncertainty related to release size, location, migration, activity, dose rate, concentration, and contaminants.
PSQ-2c: If contaminants are present above risk action levels in the sediment and contaminated sediments near the injection well, can they be mobilized and released to the SRPA as a secondary source?	SRPA COPC mobility	• Analytical concentration data (rad and non rad) • Selected soil extractions • K_d data • Model predictions • Hydraulic properties • Risk analysis	Sample core collected from injection well and nearby well • Use sample material for leach and absorption studies • Use sample material for site-specific geochemical studies • Sample and analyze Aquifer for analytes of concern • Hydraulic property analysis • Sample water in the two SRPA monitoring wells drilled to investigate I-129 hot spot. Collect water from screened interval across HI interbed.	Reduce uncertainty related to radionuclide contaminants.
PSQ-3: What are the residual contaminant concentrations in the Aquifer near Site CPP-23 of radionuclides and non-radionuclides?	Identification of Source Term	• Historical records • SRPA analytical data • Risk analysis results • Model predictions • K_d s • Hydraulic properties • OU 3-13 Group 5 interim action data	Sample Aquifer in wells drilled to investigate the injection well affects and nearby wells.	Reduce uncertainty related to non-radionuclide contaminants.

Table 4-4. (continued).

DQO Principal Study Question (DQO Step 2)	Model Needs	Inputs (DQO Step 3)	How Characterization will meet Model Requirement (from DQO Step 7)	Characterization will Provide
PSQ-4: Do localized hot spots, e.g., iodine-129 at the HI interbed, that exceed risk action levels exist in the SRPA?	COPC mobility	• Historical records • Soil analytical data • Soil-pore water analytical data • Field screening data • Risk analysis results • K_d data • Model predictions • Hydraulic properties • OU 3-13 Group 5 interim action data • OU 3-13 Group 4 data	Sample 3rd well drilled to investigate I-129 hot spot. Collect water from screened interval across HI interbed	Reduce errors in model calibration and contaminant transport.
PSQ-5 Based on new data obtained during the evaluation of the injection well, soil, and contaminated sediments near the well, will remedial action be required and what are the best remedial approaches?	Risk to the receptor in SRPA	• Final OU 3-14 injection well (Site CPP-23) COPC list • Concentration levels (water, sediment, sediments) • Contaminant mobility • Secondary source information • OU 3-13 Group 4 final action data • OU 3-13 Group 5 interim action data • Hydraulic properties • K_d data • Model predictions • Waste types • Remedial cost • Impracticability of technology • Feasibility, maturity, and efficacy of technology of technology	Drill out the injection well; core sediment within well; core material beneath well, 1.5 m (5-ft) past evidence of contamination Drill well near injection well. • core beneath 400 –ft interbed. • Sample core and analyze for contaminants Perform gamma survey Sample core collected from injection well and nearby well • Use sample material for leach and absorption studies • Use sample material for site-specific geochemical studies • Sample and analyze Aquifer for contaminants • Hydraulic property analysis Sample 3rd well drilled to investigate I-129 hot spot. Collect water from screened interval across HI interbed.	Reduce uncertainty associated with selected remedial alternatives and potential risk to receptors in the SRPA

4.5.4 Additional Soil Sites From OU 3-13

Model needs and corresponding DQOs have not been developed for these sites. Further characterization is required to determine whether modeling and development of DQOs will be required for these sites.

4.6 OU 3-14 Characterization Investigations

The OU 3-14 field investigations include those associated with Tank Farm soil, those involving the former INTEC injection well (Site CPP-23) and SRPA within the INTEC fenceline, and those involving the additional soil sites, CPP-61, CPP-81, and CPP-82. The investigations are independent of each other and both will be implemented over two phases simultaneously. The phases for the two investigations are discussed in the following sections.

4.6.1 OU 3-14 Phase I Field Investigation

The OU 3-14 Phase I investigation will include tasks for the Tank Farm soil, the Injection Well and SRPA within the INTEC fenceline, and the additional OU 3-13 soil sites. Tank Farm Soil investigation has several tasks: a surface gamma survey, an in situ gamma survey, and soil sampling of excavated soil. These tasks will be performed in a cold demonstration prior to the actual Tank Farm investigation. The Injection Well investigation will include re-opening and coring the injection well, drilling two new aquifer wells and collecting one round of groundwater samples. The OU 3-13 Additional Soil sites will require a technical paper evaluating the existing site information. All Phase I work will result in scoping meetings with the DOE-ID, EPA, and IDHW to plan the Phase II investigation and other OU 3-14 work.

4.6.1.1 Phase I Tank Farm Soil Cold Demonstration. A cold demonstration of the Tank Farm soil investigation tasks is planned to demonstrate activities and to gather operational data for the Phase I investigation at the Tank Farm. The demonstration will evaluate the methods used and potential risks associated with drilling in the OU 3-14 Tank Farm soil. The activities to be conducted during the demonstration includes: (1) surface gamma-ray mapping; (2) installation of the probehole casing using both vacuum extraction and the direct push drilling; and (3) downhole gamma-ray logging of the newly installed probehole casing.

The demonstration is expected to be conducted near the southeast corner of INTEC Building 691 (see Figure 4-1). The alluvial deposits overlying the basalt bedrock are similar to those found within the Tank Farm. Although the demonstration will be conducted in an area anticipated to be free of radiological contamination, all radiological control and other necessary precautions will be taken and surface and downhole gamma-ray logging will be performed. These procedures will be conducted in order to demonstrate that all operations can be conducted successfully and properly in contaminated areas.

The engineering survey team will survey the location for a proposed probehole similar to those in the Tank Farm Field Sampling Plan, using appropriate survey equipment. The exercise will also serve to demonstrate the process of surveying the locations of existing boreholes, however no existing boreholes are in the demonstration area.

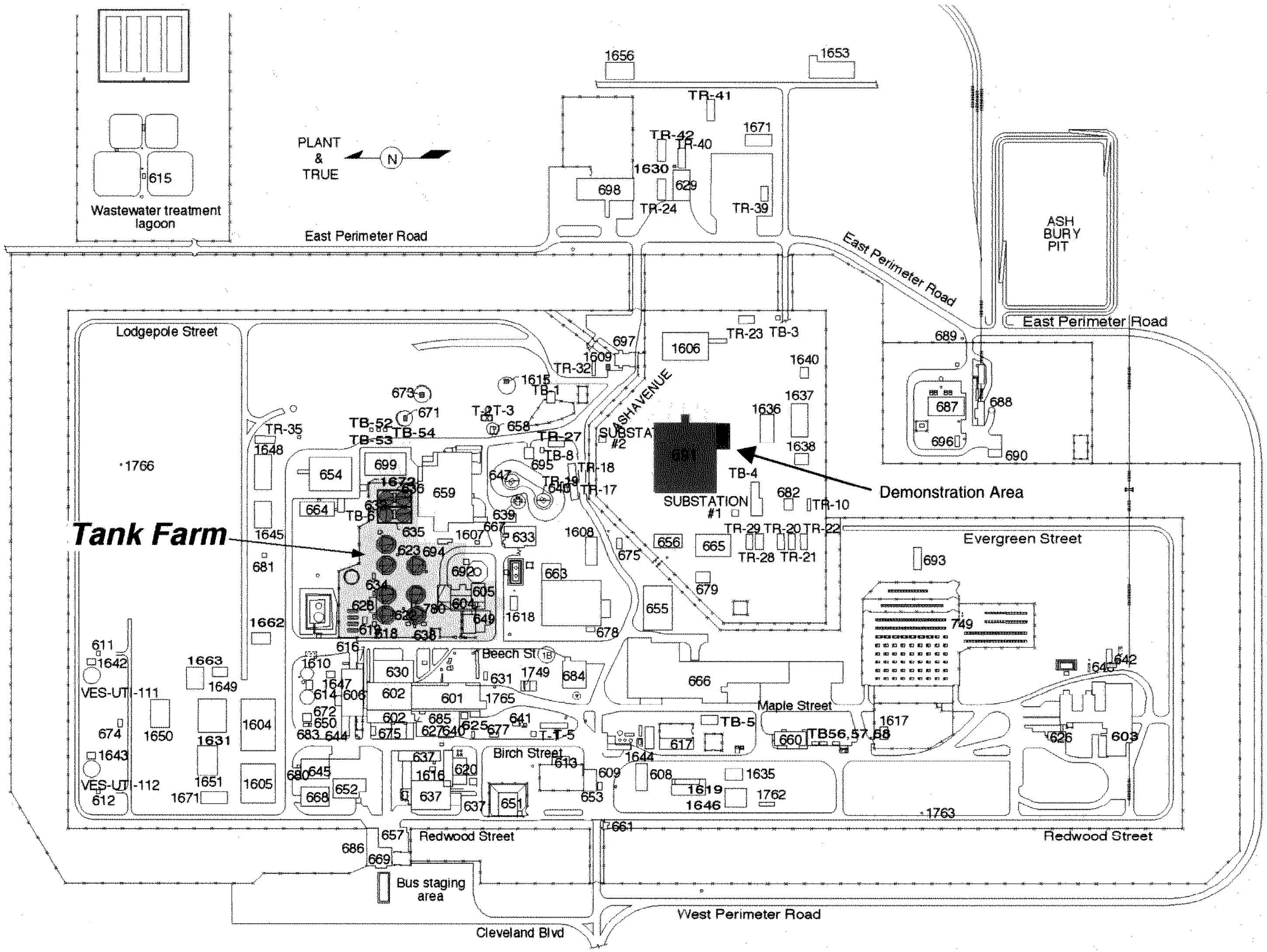

Figure 4-1 Location of the Tank Farm and Building CPP-691 testing locations within the INTEC.

A surface radiation survey of the demonstration area will be conducted using the same type of detector (e.g., a cart-mounted plastic scintillation detector). The detector will be operated at approximately 7.62 cm (3 in.) above ground surface to provide a specified area of investigation while still permitting adequate ground clearance. During the demonstration only the procedures used in the deployment of the instrument will be demonstrated. Measurements from the detector will not be required. The demonstration will validate the deployment capabilities of the instrument.

A 6.35 cm (2.5 in.) diameter steel probehole casing will be installed with a combination of vacuum extraction and direct-push drilling. A vacuum extraction unit will be used to excavate a pilot hole 12.7 to 17.78 cm (5 to 7 in.) in diameter to a depth of 4.6 m (15 ft) bgs. Excavation of the pilot hole will occur in 1.52 m (5 ft) increments. Vacuum extraction is being used in the upper 4.6 m (15 ft) to minimize the potential for damage to subsurface structures in the Tank Farm area. Vacuum extraction will be conducted using a closed loop system, with the soil finally placed in three 35- or 55-gal drums (each holding 5 foot intervals of soil). Soil will temporarily be contained in the drum(s), and then be labeled according to hole position and depth as a demonstration of the procedures for the Phase I RI/FS investigation.

Radiation surveys will be conducted during the vacuuming to simulate Tank Farm conditions. The drums will also be radiologically surveyed.

Once the pilot hole has been advanced to 4.6 m (15 ft), the drummed soil will then be backfilled around the probehole casing, unless radiological contamination is detected by the RCTs, in which case clean soil or bentonite will be used instead. The remainder of the probehole casing will be installed in 1.22 m (4 ft) sections using the direct push drill rig, to a depth of approximately 13.7 m (45 ft) bgs or to the basalt contact.

Upon completion of the probehole, the direct-push drill rig will be detached from the probehole casing at the lowest possible point above ground. The probehole casing will then be capped with an all-weather cap to preclude the inadvertent entry of unwanted material.

The installed probehole will be uncapped and logged using the downhole gamma-ray technique. Gamma-ray logging measurements will be conducted at intervals of 0.15m (0.5 ft), beginning at the lowest obtainable depth in the borehole and continuing upward to within 1 ft of the ground surface. The technique will also serve as a demonstration of logging the existing boreholes.

It is anticipated that the demonstration test and Tank Farm investigation will use a logging system with a 4.45 cm (1-1.75 in.) outer diameter and 0.662 MeV sensitivity, allowing for the detection of Cs-137. The gamma-ray logging tool will be operated in a counts/sec mode to detect and record gross gamma radiation flux with depth. During the demonstration, only the procedures used in the deployment of this instrument will be demonstrated. Logging measurements will not be obtained, as the area is expected to be free from radioactive materials. The gamma-ray logging tool is deployed using a portable winch system that provides electronic output of the detector reading and tool depth. The demonstration will validate that the winching system is accurate and that the gamma-ray logger can travel the length of the probehole casing. Under Tank Farm conditions the logging data will be acquired using a field laptop computer and graphical results showing gross gamma-ray flux will be shown in real time.

4.6.1.2 Phase I Tank Farm Soil Investigation Activities. The Phase I Tank Farm Soil Investigation will focus primarily on providing field-screening and limited soil data. The data will assist in evaluating the horizontal and vertical extent of gamma-emitting radiation (mainly Cs-137) at the site. The rationale is that all the waste streams at the Tank Farm contained Cs-137, and all the known spill and inventory data show Cs-137 as a main OU 3-13 COPC, so its presence can be used to delineate hot spots and the extent of contamination. Limited characterization will also be completed on any soils excavated during the vertical gamma screening. The Phase I data will be used to define future Phase II sampling activities.

Gamma Survey—A surface soil gamma survey across the entire Tank Farm is planned to assess the site for shallow radioactive sources and delineate radioactive subsurface structures. A mobile plastic scintillation detector will be used to determine if a residual gamma field exists at the surface for Sites CPP-24, CPP-26, CPP-30, CPP-32E, and CPP-32W, and Sites CPP-16, CPP-20, and CPP-25; identify any unknown surface gamma sources within the interstitial soil (Site CPP-96); and provide site-wide surface data for the risk assessment and feasibility study. The new data will be evaluated together with past site radiation surveys to define the shallow soil sources from 0 to 3 m (0 to 10 ft.). This information will answer DQO PSQ-1a. Magnetic, electromagnetic and ground penetrating radar surveys are being considered to help locate subsurface structures and piping prior to drilling. For details, see the OU 3-14 Tank Farm FSP (DOE-ID, 2000b).

In Situ Gamma Radiation Field Screen—An in situ gamma radiation field screening is proposed to assess the soil within the entire Tank Farm area to define the vertical and horizontal extent of the contamination throughout CPP-96, (interstitial soil), and within several specific hot spots, CPP-27/33, CPP-28/79 and CPP-31. The in situ survey will require the installation of steel casing probe holes and utilize several different detectors to log the probe holes. Refer to the Tank Farm FSP (DOE-ID 2000b) for Phase I detailed information regarding the installation of the probe holes.

For CPP-96, probe casing holes will be spaced on a grid with 15-m (50-ft) centers to evaluate the entire Tank Farm site. The grid pattern will also encompass high probability spill and leak areas such as around the tanks and piping corridors. These areas are not known to have had leaks, but their potential as source areas for contamination needs to be investigated. The probe holes will be 2 + inches in diameter and will be driven into the soil using a push technology until refusal at the soil/basalt interface. The probes will be driven to the soil/basalt to evaluate if contamination exists there and whether it is migrating horizontally beneath the Tank Farm.

For the known, hot spot sites, CPP-27/33, CPP-28/79, and CPP-31, the number of probe holes will be increased to provide better resolution of the nature and extent of the soil contamination. The spacing of probe holes needs to delineate the hot spot, the edge or limit of contamination and provide useful information to assist the DOE-ID, EPA, and IDEQ in scoping where additional Phase II soil data will be collected.

Probes will also be installed at sites CPP-16, CPP-20, CPP-25 CPP-58E, CPP-58W, and CPP-15 to provide some initial site data. These probes will also be driven to bedrock to evaluate the vertical extent of the sites. Figure 4-2 shows the proposed locations for the probe holes. This information is required to answer DQO PSQ-1b and to help plan Phase II to answer PSQ-2a, -2b, -3, -4a, and -4b.

The 85 probeholes, arranged in a 50-foot grid, located in the presumed uncontaminated locations within the Tank Farm fence will be used to investigate whether that region is contaminated. For this statistical analysis, it is assumed that an undocumented or undiscovered release is the size of the probehole—a conservative assumption.

- If some of the probeholes reveal contamination, the data will be used to estimate the extent of previously unrecognized contamination, and to infer problem locations. Phase II will follow up on any such findings.

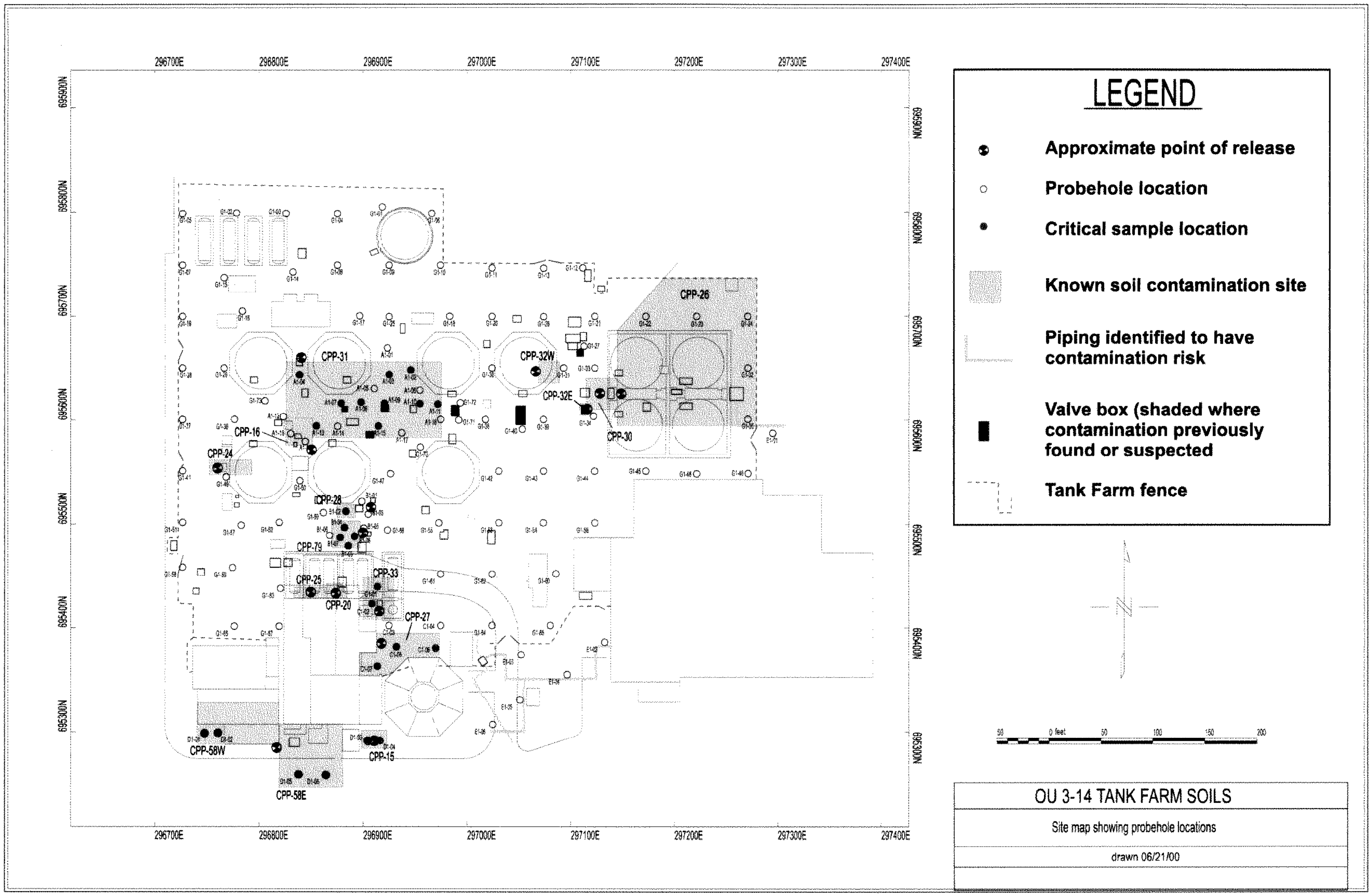

Figure 4-2. Map showing the in situ gamma radiation field survey probe hole locations.

- If, instead, the 85 probeholes find no hot spots, we can conclude with 90% confidence that at least 97.3% of the nominally uncontaminated region is truly uncontaminated. Other confidence statements are also possible. For example, with 95% confidence, at least 96.55% of the region is truly uncontaminated. The equation used is:

$$(\text{fraction of land uncontaminated})^{85} = 1 - \text{Confidence Level}$$

It is impossible to guarantee that no undiscovered hot spots exist, except by excavating the entire site. However, if the nominally clean area is sampled and 85 samples find no hot spots, confidence statements like those above can be made regarding the limits of possible contamination. Such limits can be used in later risk calculations.

Limited Tank Farm Soil Sampling—The installation of the probes at the Tank Farm will require positive assurance that the tank operations and underground utilities (waste piping, coolant pipes, cathodic protection, hydraulic lines, power, etc.) will not be damaged. A vacuum excavator will be used to excavate soil to a depth of 5 m (15 ft) bgs to ensure the hole is deeper than any known utilities, then place the pipe past any utilities and backfill the hole. Then the probes will be driven or pushed to refusal or bedrock. A safety analysis and demonstration needs to be completed to ensure the activity of driving or pushing the probes will not exceed the seismic limit for the Tank Farm or result in any excessive vibrations.

The vacuum excavator will be able to make a 7 – 13 cm (3 –5 in.) diameter hole and deposit the excavated soil into a drum. The soil will be excavated in 1.5 m (5-ft) increments and temporarily stored inside of the INTEC Tank Farm site. If the excavated soil is below 5 mR, it will be returned to the excavation, if possible. If the soil cannot fit down the annular space between the probe casing and excavated hole, then clean sand will be used to fill the annular void space. Excavated soil that exceeds 5 mR will not be returned to the hole because of ALARA concerns and to avoid unnecessary exposures.

The use of the vacuum excavator allows an opportunity to investigate and collect soil samples across the Tank Farm. The soil will be surveyed as it is excavated to provide a general field screening. The excavated soil and the excavation will be examined for physical features such as soil type, wetness, color, staining, gravel content etc. Limited soil samples will be collected for full radiological analyses and CLP metals from 0 – 1.5 m (0 – 5-ft), 1.5 – 3.0 m (5– 10-ft), and 3 – 4 m (10 – 15 ft). Soil samples will be collected from the following areas;

- Site CPP-96 –Composite soil samples will be collected from each 1.5 m increment from 20% of the planned probe hole locations.

- Site CPP-31, Site CPP-28/79, and Site CPP-27/33 – Soil is planned to be drummed from every location at these sites and stored on site for characterization and feed material for contaminant transport and treatability studies. It is planned that soil samples will be collected from each increment in at least 5 probeholes from Site CPP-31, 3-5 probeholes from Site CPP-28/79, and 3-5 probeholes from Site CPP-27/33. The final estimate and location of samples will be determined, pending DOE-ID, EPA, and IDEQ review of the in situ gamma radiation field screening data. These analyses do not need to be done immediately since the drums will be stored and there are no holding times associated with the contaminants.

- Soil will be collected and analyzed from any other site if it exceeds the 5 mR/hr limit and can not be returned to the excavation.

Soil that is less than 5 mR/hr will be composited over the full 1.5 m (5-ft) length and sampled. Soil that exceeds the 5 mR/hr limit will be drummed, and stored until a decision is made as to what sampling is required. The drummed soil will be stored either beneath the INTEC Tank Farm site or an approved CERCLA storage area within INTEC as Investigation Derived Waste. Then the drums will be transferred to the INTEC Radiological Analysis Laboratory (RAL). The RAL will conduct the sampling and analysis of the soil within a hot cell environment. Preliminary sampling strategies and analytical requirements are presented in detail in the attached Phase I Tank Farm FSP. This IDW may be used for additional sampling as part of Phase II, the Contaminant Transport Study, or the Treatability Studies.

4.6.1.3 Phase I Injection Well/Aquifer Investigation Activities. The aquifer well drilling program focuses on contamination associated with the former ICCP injection well (Site CPP-23). The concerns to be addressed are (1) whether a source of contamination is present in the sediment emaining inside the injection well below the grout seal, (2) whether contamination exists in the SRPA adjacent to the injection well, (3) whether any slow moving contaminants are present in the aquifer in the vicinity of the injection well, and (4) whether I-129 contamination exists in the HI interbed.

One boring will be attempted through the grout seal and sediment within the former injection well with the intent to collect a continuous core sample of the sediment remaining in the well. The approach is to drill the grout seal, and core the sediment remaining within the former injection well to the original well depth of 183 m (600 ft). The sediment core will be composite-sampled for COPCs identified in Table 5-1 of the Injection Well FSP (DOE-ID 2000a) over the following 3-m (10-ft) intervals: 137 to 140 m, 146 to 149 m, 156 to 159 m, 165 to 168 m, 174 to 177 m, 183 to 186 m, and 192 to 195 m (450 to 460 ft, 480 to 490 ft, 510 to 520 ft, 540 to 550 ft, 570 to 580 ft, 600 to 610 ft, and 630 to 640 ft, respectively). In addition, discrete samples will be collected from those portions of the sediment core that contain contamination based on radiological field screening or visual observation. The coring will continue in 1.5-m (5-ft) increments past the bottom of the injection well until radiological field screening or visual observations indicate that the vertical extent of contamination has been reached. Coring will continue 1.5 m (5-ft) below the depth where contamination was last observed. It is anticipated that the final depth of the well will be approximately 198 m (650 ft) bgs. If this boring breaches the existing casing before the target depth is reached, one attempt will be made to re-center the boring, continue drilling and coring within the existing well structure, and complete the task. The sampling and drilling procedures are presented and discussed in detail in the Injection Well Field Sampling Plan (DOE-ID 2000a).

Two additional aquifer wells will be drilled to investigate the SRPA groundwater quality within the INTEC fence line. The aquifer wells will be completed to the aquifer, penetrating the HI interbed to a depth of approximately 174 m (570 ft) bgs. The final depth of these aquifer wells will depend on the final depth of coring in the abandoned injection well. The proposed well locations are: one aquifer well located adjacent to the site CPP-23 Injection Well and one aquifer well located down gradient of site CPP-23 to investigate the potential for residual contamination in the aquifer from the use of the injection well. The entire vadose zone in the aquifer well adjacent to the injection well will be cored. The core will be maintained by OU 3-14. Figure 4-3 shows the proposed locations where the wells will be installed. Figure 4-4 is a cross section showing the HI interbed in the vicinity where the proposed well will be drilled. The wells will be screened across the HI interbed.

4.6.1.4 OU 3-13 Additional Soil Sites. The OU 3-13 Additional Soil sites, CPP-61, CPP-81, and CPP-82, will be re-evaluated in Phase I. The re-evaluation will address the DOE-ID, EPA, and IDEQ uncertainties with each site using existing historical information. Technical papers will be submitted for DOE-ID, EPA, and IDEQ review, and if a risk or uncertainty is determined for a site, then scoping meeting will be held to determine data needs for Phase II sampling.

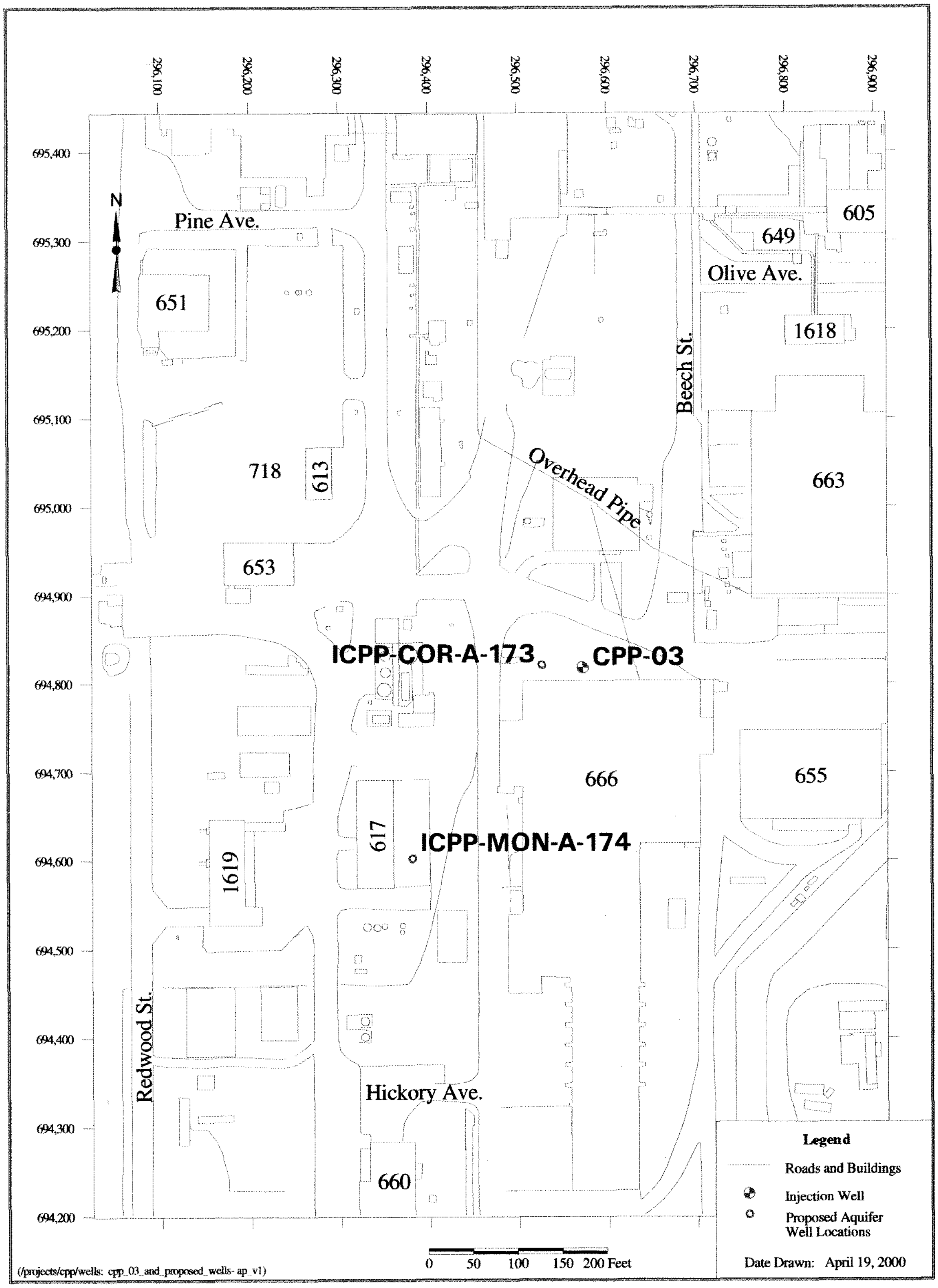

Figure 4-3. Map showing locations of three proposed aquifer wells.

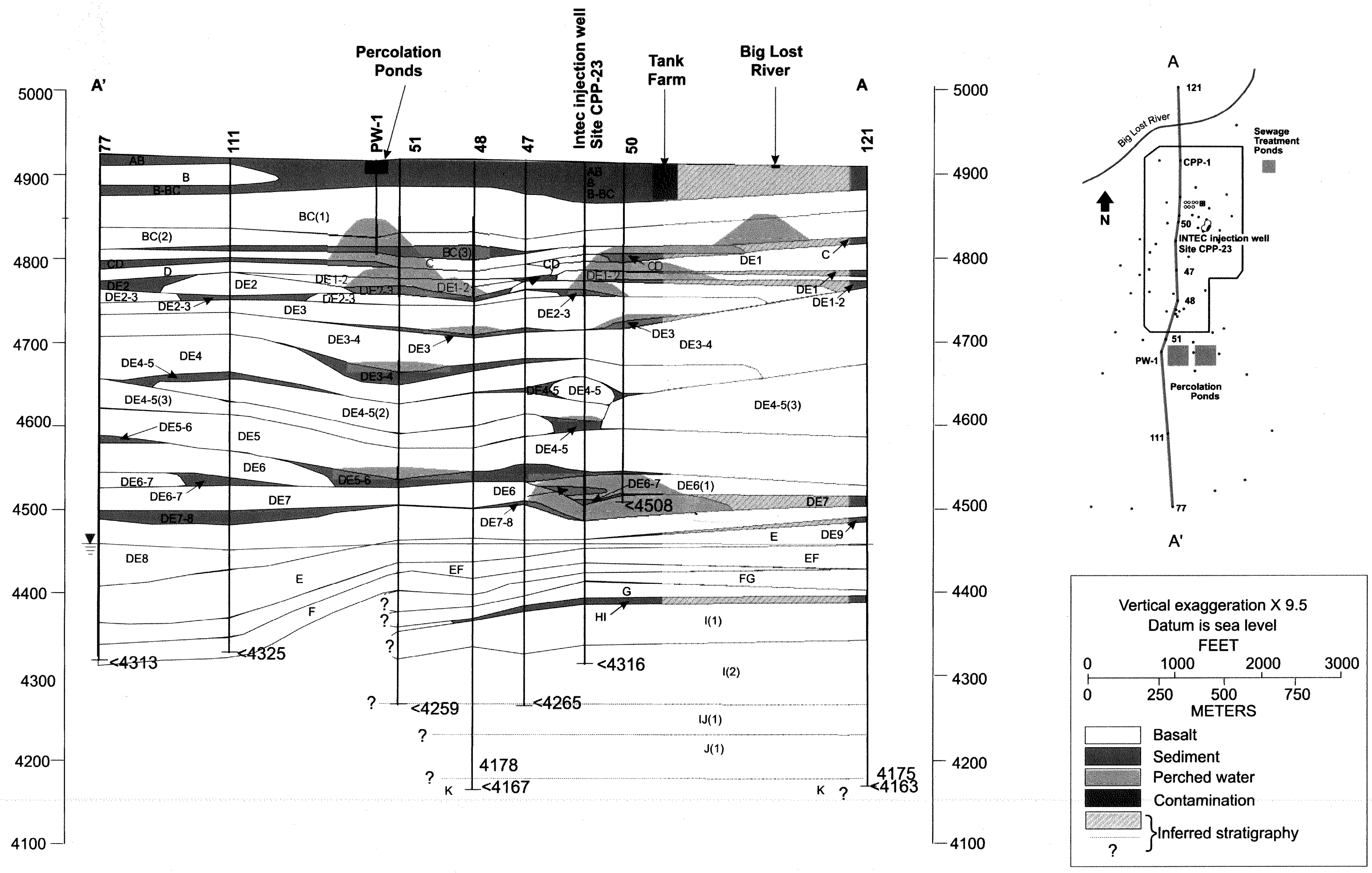

Figure 4-4. Cross-section running north to south showing HI interbed.

4.6.1.5 Scoping Meetings. Periodic and timely scoping meetings will be held with the DOE-ID, EPA, and IDEQ for updates on the field investigations and review the Phase I data. As data are collected they will be analyzed and provided to the DOE-ID, EPA, and IDEQ in letter reports for their review prior to any scoping meeting. Key topics for DOE-ID, EPA, and IDEQ input that can be projected for Phase I are the following:

- Results of the Surface Gamma Survey to plan additional Deep Probe locations
- Results of the In Situ Gamma Survey to plan additional Deep Probe locations
- Results of limited characterization of excavated soil
- Results of the Technical Review of the OU 3-13 Additional Soil sites
- Results of the Injection Well Coring
- Results of the Aquifer Monitor Well Drilling
- Results of the 1st Groundwater Sampling from the two Aquifer monitoring wells
- Planning Phase II Sampling and Analysis Plan Objectives for the Tank Farm soil and two monitoring wells
- Review of the Risk Assessment and Groundwater Strategy Papers
- Review of the Contaminant Transport Study and Treatability Study Proposals
- Review of the OU 3-14 RI/FS Scoping of Remedial Alternatives and Data Needs

4.6.2 OU 3-14 Phase II Field Investigation

The OU 3-14 Phase II Field Investigation will occur in future years and consists of collecting additional sampling data to satisfy the OU 3-14 DQOs (see Section 4.4). The results of the Phase I Field Investigation will be reviewed with the DOE-ID, EPA, and IDEQ and the specific site data necessary to evaluate remedial alternatives for OU 3-14 will be defined in a Characterization Work Plan (CWP). It is anticipated that Phase II Field Investigation will include: additional soil data collection from the Tank Farm Soil site, groundwater sampling at the two monitoring well sites, collecting any needed data from the OU 3-13 Additional Soil sites, finalizing the strategy for the OU 3-14 risk assessment and groundwater modeling, and starting the Contaminant Transport and Treatability Studies. Groundwater sampling and analyses, and sampling frequency, will be determined after evaluating Phase I results.

4.6.2.1 Phase II Tank Farm Soil Investigation Activities. The results of the Phase I Surface Gamma Survey and In Situ Gamma Survey will delineate the presence of any gamma-emitting hot spots. These results will be reviewed together with the historical site information to plan additional soil sampling needs. It is anticipated that there will be surface spill hot spots (CPP-24, CPP-26, CPP-30, and CPP-32 E and W) and deep hot spots (CPP-15 and CPP-58 E and W) to further investigate. The surface spill sites are anticipated to be low activity contamination and are planned to be sampled with conventional sampling techniques. The number, location, and type of sampling will be defined in the Phase II CWP.

Radiation Sampling. The deeper hot spots will likely include Sites CPP-16, CPP-20, CPP-25, CPP-15, CPP-58E & W, CPP-27/CPP-33, CPP-28/CPP-79, CPP-31 or in the interstitial soil (CPP-96). Additional soil data will be collected from these sites using either conventional drilling and sampling methods and/or remote, In Situ methods. Conventional methods will likely be used if the Phase I data indicate that radiation levels at these deeper sites do not pose an unreasonable exposure hazard. At deep hot spot sites where an unreasonable exposure hazard exists, it is planned that radiological data will be collected from the hot spot using In Situ methods and other soil data will be collected adjacent to, above and/or beneath the hot spot.

Plans call for collecting the in situ radiological data using large diameter 10 to 12.7 cm (4 to 5 inches) probe holes. These larger diameter probes will be able to utilize various radiation detectors and logging devices to speciate different radionuclides. The exact detectors, target radiological analytes, and sampling and analytical methods will be adopted with DOE-ID, EPA, and IDEQ involvement and presented in the Phase II Characterization Work Plan. For budgetary planning purposes, up to eight instrumented probe (assuming there are four hot spots requiring two probes each) will be installed to speciate the radionuclides and provide a vertical profile (surface to soil/basalt contact) through the areas of concern.

Soil Sampling. Soil samples will be collected for contaminant characterization, treatability studies, hydraulic property determination, and feasibility study parameters. The location, number and typed of samples required will be defined during DOE-ID, EPA, and IDEQ scoping meetings following the submittal and review of the Feasibility Study, Treatability Study, and Contaminant Transport Study Technical papers.

Soil Moisture Monitoring Activities. Soil moisture stations will also be installed. It is anticipated that three background stations and eight contaminant source stations inside the Tank Farm will be required. Each station will likely include several probe holes instrumented with a neutron-probe access tube, tensiometers, moisture sensors, thermocouples, and suction lysimeters. All electronic information will be collected in data loggers and remotely down loaded to a computer. Associated data loggers and radios to transmit data will be installed at each station. The final locations, instruments, and sampling and analysis methods will be defined in the Phase II Characterization Work Plan.

Several instruments are planned for use. The neutron-probe and Cone Penetrometer Test (CPT)/Resistivity probes, will permit collection of moisture content both vertically (depth) and horizontally (lateral). The neutron probe will provide a continuous moisture profile with depth for the Tank Farm soil, while the CPTs provides the capability to collect automated point-source volumetric moisture content data. Both are required to develop accurate infiltration estimates for the calculation of flux rates. Tensiometers will be used to determine hydraulic gradient for moisture movement in the soil. Suction lysimeters will be used to collect soil pore water samples for contaminant analyses from within and below each hot spot. The information collected from the moisture stations will enable determination of vertical and horizontal flux rates through the Tank Farm soil and yield information about contaminant mobility and transport (DQO PSQ-3, -4a, and -4b).

The soil moisture will be monitored in two background locations outside the Tank Farm area and one within the Tank Farm but in an area that is considered “cold”. Eight monitoring stations will be within the Tank Farm hot spots. The planned background locations are (1) outside the INTEC fence and adjacent to the Big Lost River; (2) outside the INTEC fence and south of the Tank Farm; (3) inside the Tank Farm and adjacent to the New Waste Calciner Facility (see Figure 2-10). Each background location will have an auger hole drilled to collect site-specific soil data to calibrate the neutron moisture logging technique. In addition, samples for soil chemistry, moisture, physical properties, and contaminant leaching/absorption tests will be collected.

4.6.2.2 *Phase II Aquifer Investigation Activities.* Groundwater samples may be collected for up to four years from the two new aquifer wells installed at INTEC. The types and frequencies of analyses required will be determined after the results of Phase I are evaluated. Other long-term activities that may be required are the need for additional aquifer wells. These activities will be decided on once the Phase I data have been reviewed. There are no Phase II activities for the injection well (Site CPP-23).

4.6.2.3 *Phase II OU 3-13 Additional Soil Sites Activities.* Additional soil samples may be necessary from sites CPP-61, CPP-81, and/or CPP-82 pending the review and evaluation of the technical papers by the DOE-ID, EPA, and IDEQ. The types and numbers of samples required, sampling locations, and sampling and analysis methods will be determined after the technical papers have been reviewed and evaluated by the DOE-ID, EPA, and IDEQ.

4.6.2.4 *Contaminant Transport Studies.* The anticipated scope of a Contaminant Transport Study for the Tank Farm is to experimentally determine site-specific adsorption and desorption coefficients for OU 3-14 Tank Farm soil COPCs on Tank Farm geological materials. The Contaminant Transport Study provides the background and technical approach for quantifying the sorptive behavior of the COPCs in the OU 3-14 Tank Farm soil.

There are three pieces of information needed for the Tank Farm soil. These are (a) the release of contaminants from sources in the Tank Farm soil, (b) the vertical profile of retardation capabilities, and (c) the spatial variability of retardation capabilities. Source-release information will be gathered by performing leach tests on Tank Farm soil. Retardation capabilities would be carried out on Tank Farm soil samples for OU 3-14 COPCs identified for the Tank Farm soil. Decision on where samples should be collected, and at what depths can be determined as more information is gleaned from characterization of the Tank Farm soil. If collected the contaminant transport data will be used in the fate and transport model to assess remedial alternatives.

4.6.2.5 *Treatability Studies.* Tank Farm treatability studies are foreseen for two areas: 1) the encapsulation and immobilization of OU 3-14 Tank Farm soil COPCs (both residuals in the Tanks and spills/leaks in the soil), and 2) removal of specific hot spots, ex situ treatment (if needed) and disposal. The encapsulation and immobilization of the COPCs could entail treatability studies using polymer injection, reactive barriers, and an engineered cap.

Injection well treatability studies are predicated upon the depth of the source terms of interest. The efforts directed toward treatability studies could include (1) grout/polymer injection, (2) bioclogging, (3) adsorption, and (4) investigation of the efficacy of plume interception by pump-and-treat methods.

4.6.2.6 *Baseline Risk Assessment.* A baseline Risk Assessment (BRA) will be performed for the Injection Wells portion of the project only, since the Tank Farm soil is already assumed to pose a risk. If a risk assessment is necessary for the Tank Farm soil, then the level of assessment will be negotiated with DOE-ID, EPA, and IDEQ. A technical paper will be developed and presented to DOE-ID, EPA, and IDEQ.